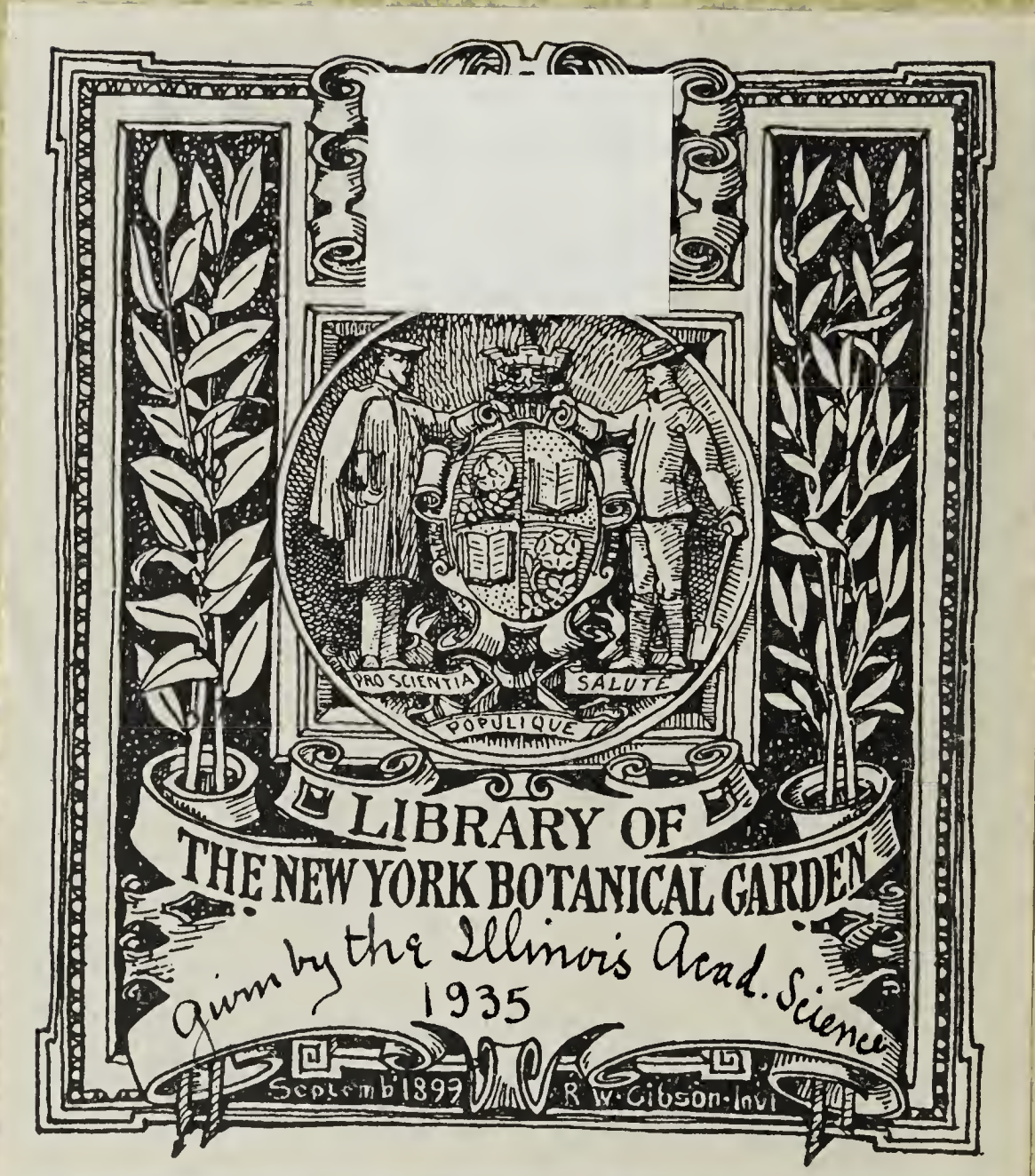
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TRANSACTIONS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

TRANSACTIONS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

VOLUME XXV

1932-1933

EDITED BY DOROTHY E. ROSE

Printed by authority of the State of Illinois

DEPARTMENT OF REGISTRATION AND EDUCATION

STATE MUSEUM DIVISION, CENTENNIAL BUILDING

SPRINGFIELD, ILLINOIS

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vol 25-26

VOLUME XXV

NUMBER 1—SEPTEMBER, 1932

Announcement of the Twenty-sixth Annual Meeting, East St. Louis, Illinois, May 5 and 6, 1933.

NUMBER 2—DECEMBER, 1932

Papers presented in General Sessions at the Twenty-fifth Annual Meeting; Minutes of Council Meetings; Constitution and By-Laws; Memoir of Samuel W. Parr.

NUMBER 3—MARCH, 1933

Minutes of the Meetings of the 1932-1933 Council; Minutes of Twenty-sixth Annual Meeting; Reports of Officers and Committees.

NUMBER 4—JUNE, 1933

Papers Presented in the Twenty-fifth Annual Meeting, Chicago, Illinois, May 6 and 7, 1932.

TRANSACTIONS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

VOL. 25 SEPTEMBER, 1932 NUMBER 1

Announcement
Twenty-sixth Annual Meeting

General Program, Section Meetings, Junior Section
Proposed Amendments to the Constitution
Instructions to Authors
General Information

Friday and Saturday, May 5-6, 1933
East St. Louis, Illinois

Department of Registration and Education
State Museum Division, Centennial Building
Springfield, Illinois

Entered as second-class matter, December 6, 1930, at the post office at Springfield, Illinois, under Act of August 24, 1912.

GENERAL PROGRAM

(All Addresses and Section Meetings Are Open to the Public)

THURSDAY, MAY 4

7:30 p.m. Meeting of the Council *(Peacock Room, Broadview Hotel).*

FRIDAY, MAY 5

8:00 a.m. Registration by all members and guests; securing of final program and tickets for the annual banquet; registration for Saturday field trips *(Lobby of Broadview Hotel).*

8:00 a.m. Meeting of the Council with local committee and delegates from affiliated societies *(Peacock Room).*

9:00 a.m. Preliminary business meeting of the Academy. Election of new members; appointment of committees on nominations, on resolutions, and on auditing; adjournment until 11:30 a.m. *(Ball Room).*

9:30 a.m. Twenty-sixth annual meeting, general session *(Ball Room).*
Address—*Bio-chemistry of the Human System.*
Address—*What Animal Experimentation has done for the Advancement of Human Life and Happiness.*
Address—*The Science of Nutrition.*

11:30 a.m. Annual business meeting of the Academy. Reports of officers and committees; other business; adjournment until 5:00 p.m.

12:00-1:30 p.m. Luncheon *(Broadview Hotel).* 50 cents.

1:45 p.m. Section meetings. Election of section chairmen for 1933-34; papers, demonstrations, discussions *(East St. Louis High School).* Meeting places for each section will be announced in the final program.

5:00 p.m. Final business meeting of the Academy *(Auditorium, East St. Louis High School).* Reports of committees; election of officers for 1933-34; appointments to standing committees; other business; adjournment.

7:00 p.m. Annual banquet (informal), *(Ball Room).* Reservations should be made in advance (apply to F. L. Eversull, High School, East St. Louis, Ill.) and tickets should be secured at Registration Desk at time of registration. $1.50 per plate.

7:45 p.m. Annual public lecture *(Broadview Hotel).*
Address of Welcome—FRANK DOYLE, Mayor, East St. Louis.
Response—HARRY F. FERGUSON, President, Illinois State Academy of Science.
Advances in the Science of Public Health—DR. FRANK J. JIRKA, Director of the State Department of Public Health, Springfield.

SATURDAY, MAY 6

8:00 a.m. Meeting of the new Council *(Peacock Room).*

9:00 a.m. Inspection trips leave from Broadview Hotel. The local committee will arrange for transportation for those who do not have their own means of transportation. Register for one of the trips at the time of general registration.

Anthropological trip—a visit to Cahokia Mounds Park, conducted by Dr. A. R. Kelly, University of Illinois, Urbana. Two and one-half hours, party may return to hotel by noon.

Botanical trip—a visit to Missouri Botanical Gardens (H. Engelmann herbarium, cactus house, arobetum, iris beds—1,000 varieties), conducted by Dr. H. S. Pepoon, Illinois State Natural History Survey, Urbana. Two hours, party may return to East St. Louis by 11:30 a.m.

Geological Trip—a visit to an exposure of the "Coal Measures" strata, the Dupo anticline, the Valmeyer anticline, a limestone mine, and interesting Pleistocene features, conducted by Dr. M. M. Leighton, Illinois State Geological Survey. Trip will terminate near Valmeyer, Illinois, by 3:00 p.m.

Geographical trip—to be announced.

The local committee will arrange for the following conducted trips if they are requested: *Agricultural trip*—a visit to East St. Louis Packing Plants; *Chemical trip*—a visit to Montsanto Chemical Works; *Physics trip*—a visit to the Cahokia Power Plant.

PROGRAM OF SECTION MEETINGS

FRIDAY, MAY 5—1:45 P. M.

EAST ST. LOUIS HIGH SCHOOL

AGRICULTURE

South Cafeteria

H. W. Mumford, University of Illinois, *Chairman*

Election of chairman for 1933-34.

Symposium: Problems of the Soybean Industry.

1. History of soybean development in the United States—C. H. Oathout, Western Illinois State Teachers College, Macomb.
2. Methods of soybean production—W. L. Burlison, University of Illinois, Urbana.
3. The use of soybeans as human food—Sybil Woodruff, University of Illinois, Urbana.
4. The use of soybeans as feed for livestock—C. W. Hudelson, Illinois State Normal University, Normal.
5. The use of soybeans in industry—Otto Eisenschiml, Scientific Oil Compounding Company, Chicago.
6. The economic bases for present and future production of soybeans in Illinois—R. C. Ross, University of Illinois, Urbana.

ANTHROPOLOGY

North Cafeteria

A. R. Kelly, University of Illinois, *Chairman*

Election of chairman for 1933-34.

1. Parallelism in pottery decoration between Cahokia and southeastern Europe—G. E. Mylonas, University of Illinois, Urbana.
2. Soil science for the archaeologist—E. A. Norton, University of Illinois, Urbana.
3. Further notes on the archaeology of Jersey County—P. F. Titterington, St. Louis, Missouri.
4. An archaeological survey of Cahokia Creek east of Collinsville bluffs—W. H. Hunter, University of Illinois, Urbana.
5. Projected research in the archaeology of the Ohio-Mississippi confluence in southern Illinois—Bruce Merwin, Southern Illinois State Normal University, Carbondale.

BOTANY

Biology Laboratory

H. S. Pepoon, Illinois State Natrual History Survey, *Chairman*

Election of chairman for 1933-34.

1. Additions to *Flora Peoriana*—Virginius H. Chase, Peoria Heights.
2. Scientific botanical design—Emma C. Crummer, Oak Park.
3. Conservation of wild flowers and shrubs a community duty—L. F. Gumbart, Macomb.
4. Early winter injury to some common trees and shrubs—Hubert A. Harris, Illinois State Natural History Survey, Urbana.
5. A comparison of the size range and the external characteristics of the spores of modern and fossil Lycopods—Orrin J. Henbest, University of Illinois, Urbana.
6. Pollen analysis of some water-deposited sediments—P. K. Houdek, Robinson.
7. *Primula mistassinica* in Illinois and the United States—H. S. Pepoon, State Natural History Survey, Urbana.
8. Persistence of sub-specific types of *Xanthium* under field conditions—Charles A. Shull, University of Chicago, Chicago.
9. The skunk cabbage in winter—Jesse L. Smith, Highland Park.
10. Grassland in the floodplains of Illinois rivers—Lewis M. Turner, University of Arkansas, Fayetteville, Arkansas.
11. Rust observations in the Illinois winter wheat areas, 1932—Kenneth Wright, Bloomington.

12. Apple River Canyons—H. S. Pepoon, Illinois State Natural History Survey, Urbana.
13. Conservation of natural phenomena—Jens Jensen, Ravinia.
14. Material for developing the technique of consumption—M. Faith McAuley, University of Chicago, Chicago.
15. Forest distribution in Crawford County, Illinois—S. Ray Bradley, Robinson.
16. False Indigos of the Mississippi Valley—J. M. Greenman, Missouri Botanical Garden, St. Louis, Mo.

CHEMISTRY

Boys' Gymnasium

George C. Ashman, Bradley Polytechnic Institute, Peoria, *Chairman*

Joint session with Physics section for papers 1-5

1. Liquid oxygen—a lecture-table demonstration—C. T. Knipp, University of Illinois, Urbana.
2. A new experiment showing that cathode rays leave the cathode surface normally—C. T. Knipp, University of Illinois, Urbana.
3. A rectifier having cold cathodes—C. T. Knipp, University of Illinois, Urbana.
4. The magneto-optic method of analysis—B. S. Hopkins and Gordon Hughes, University of Illinois, Urbana.
5. A study of boiler waters in high-pressure plants—Donald B. Keyes, University of Illinois, Urbana.

Chemistry Section

Election of chairman for 1933-34

6. Activity coefficients of hydrochloric acid—T. F. Young, University of Chicago, Chicago.
7. Pressure in bubbles—T. F. Young, University of Chicago, Chicago.
8. Acidification and purification of polysaccharide solutions by means of electricity—V. R. Hardy, University of Illinois, Urbana.
9. Syrup from Jerusalem artichokes—F. A. Dykins and D. T. Englis, University of Illinois, Urbana.
10. Evaluating a high school chemistry course—John C. Chiddix, Normal.
11. The value of valence and when to teach it—E. E. Rademacher, Nokomis.
12. How important is the time factor in examination? J. H. Sammis, Peoria Central High School, Peoria.
13. What shall we do about that chapter on photography? J. H. Sammis, Peoria Central High School, Peoria.

ECONOMICS

Music Room 212

Walter H. Voskull, Illinois State Geological Survey, *Chairman*

Election of chairman for 1933-34.

Symposium: Problems of the Illinois Coal Industry.

1. Competition of Appalachian coals, fuel oil, natural gas and other fuels with Illinois coal in the Illinois coal market area—W. H. Voskuil, Illinois State Geological Survey, Urbana.
2. Economic importance of coal cleaning and coal preparation to the Illinois coal producing industry—D. R. Mitchell, University of Illinois, Urbana.
3. The growth of coal shipments by motor truck into St. Louis and its effect on the transportation and mining industries—Frank F. Tirre, Better Business Bureau of East St. Louis.
4. Competitive position of fuel oil and natural gas with coal in the St. Louis district.
5. Discussion.

GEOGRAPHY

Room 104

Ruby Harris, Eastern Illinois State Teachers College, Charleston, *Chairman*

Election of chairman for 1933-34.

1. A study of the land utilization of Towanda Township—Margaret Means, Bloomington High School, Bloomington.

2. The apple industry of Calhoun County—Alfred W. Kasel, Moline High School, Moline.
3. The broom corn industry of Coles County—Rose Zeller, Eastern Illinois State Teachers College, Charleston.
4. Reconnaissance traverse in Ontario Peninsula—Charles C. Colby, University of Chicago, Chicago.
5. Father Nile and Egyptian agriculture—W. O. Blanchard, University of Illinois, Urbana.
6. Problems of land utilization in Antrim County, Michigan—Herbert N. Cowles, Northwestern University, Evanston.
7. Distribution of fisheries of the North Atlantic—Vellora Foster, Northwestern University, Evanston.

GEOLOGY

Room 204

J. E. Lamar, Illinois State Geological Survey, *Chairman*

Election of chairman for 1933-34.

1. Micrography of the lead and zinc ores of the Upper Mississippi Valley—A. F. Banfield, Northwestern University, Evanston.
2. Edgewood scolecodonts—Paul H. Dunn, University of Chicago, Chicago.
3. The extinct lake San Augustin, New Mexico—W. E. Powers, Northwestern University, Evanston.
4. Origin and economic importance of bedding-plane movements—Charles H. Behre, Northwestern University, Evanston.
5. Chert in the Niagaran formation in the vicinity of Chicago—J. R. Schultz, Northwestern University, Evanston.
6. The Warsaw formation—J. Marvin Weller, Illinois State Geological Survey, Urbana.
7. Cleating in coal—E. C. Dapples, Northwestern University, Evanston.
8. A study of the interval between the Shoal Creek limestone and coal No. 6 in Illinois—M. W. Fuller, University of Illinois and State Geological Survey, Urbana.
9. Some Pennsylvanian limestones of the Carlinville quadrangle—John R. Ball, Northwestern University and State Geological Survey.
10. Stratigraphy of the Okaw formation in southwestern Illinois—A. H. Sutton, University of Illinois, Urbana.
11. Pennsylvanian rocks of Madison and St. Clair counties, Illinois—H. R. Wanless, University of Illinois and State Geological Survey, Urbana.
12. Pleistocene history of the East St. Louis region—M. M. Leighton, Illinois State Geological Survey, Urbana.
13. Subsurface stratigraphy in the East St. Louis region—G. E. Ekblaw and L. E. Workman, Illinois State Geological Survey, Urbana.
14. Our present knowledge of American coal-ball plants—A. C. Noé, University of Chicago and Illinois State Geological Survey.
15. Stratigraphic position of the Hoing Sand—L. E. Workman, Illinois State Geological Survey, Urbana.

MEDICINE AND PUBLIC HEALTH

Frank J. Jirka, Director, State Department of Public Health, Springfield, *Chairman*

As the general session for the Twenty-sixth Annual Meeting is devoted to the interests of this section, no section meeting will be held.

PHYSICS

Boys' Gymnasium

Otis B. Young, Southern Illinois State Normal University, Carbondale, *Chairman*

Joint session with Chemistry section for 5 papers. (See titles 1-5 of Chemistry Program.)
Election of chairman for 1933-34.

1. Methods of detection and measurement of ionization in dielectrics—J. Tykocinski Tykociner, University of Illinois, Urbana.
2. A balanced bridge for testing of insulation—Hugh A. Brown, University of Illinois, Urbana.
3. Comparative study of the effect of discharges in cables—Ellery B. Paine, University of Illinois, Urbana.
4. Mechanism of bead discharges in cylindrical tubes—J. Tykocinski Tykociner, University of Illinois, Urbana.
5. Photoelectric effect of caesium vapour—Jacob Kunz, University of Illinois, Urbana.
6. A list of physics books of historical interest in the colleges of Illinois—Clarence R. Smith, Aurora College, Aurora.
7. An electron-coupled harmonic amplifier—D. E. Chapman, University of Illinois, Urbana.

PSYCHOLOGY AND EDUCATION

Girls' Gymnasium

Ralph W. Pringle, Illinois State Normal University, Normal, *Chairman*

Election of chairman for 1933-34.

1. The quality of extension work—Clem O. Thompson, University of Chicago, Chicago.
2. Unmeasured values in education—George D. Wham, Southern Illinois State Normal University, Carbondale.
3. Relative effectiveness of different intervals between learning and reviewing—Mary C. Ellis, Norine Toohill, Pearl Kloess, and H. A. Peterson, Illinois State Normal University, Normal.
4. A psychological view of the depression—James A. Melrose, James Millikin University, Decatur.

ZOOLOGY

Library

William P. Hayes, University of Illinois, *Chairman*

Election of Chairman for 1933-34.

The section will meet as a whole for the presentation of papers 1-5 and will divide into an Entomology Division and a Zoology Division for the presentation of the remaining papers.

1. Student points of view in biology—W. V. Balduf, University of Illinois, Urbana.
2. Biology in human behavior—C. E. Montgomery, Dekalb.
3. Family origins in a southern Illinois community—Clarence Bonnell, Harrisburg.
4. A concept of species among fishes—David H. Thompson, State Natural History Survey, Urbana.
5. Albertus Magnus, thirteenth century zoologist—Sister Mary Ellen O'Hanlon, Rosary College, River Forest.

Zoology Division

6. Habitat of *Sphaerium solidulum*, with notes on other Sphaeriidae—T. Dale Foster, University of Illinois, Urbana.
7. Morphological and life history studies on *Stylet cercariae*—D. B. McMullen, Monmouth College, Monmouth.
8. Shell injuries of land mollusks—T. Dale Foster, University of Illinois, Urbana.
9. Molluscan fauna of the great river valleys of Illinois—Frank C. Baker, University of Illinois, Urbana.
10. A study of the pharyngeal teeth in the blunt-nosed minnow *(Hyborhynchus notatus)* —Ray Chambers, University of Illinois, Urbana.
11. *Ambystoma talpoideum* in Illinois—Hilda A. Stein, Southern Illinois State Normal University, Carbondale.
12. Variation among a typical spermatozoa in *Valvata tricarinata*—C. L. Furrow, Knox College, Galesburg.
13. Natural vs. accidental death in different habitats of the snail *Viviparus contectoides* —Harley J. Van Cleave, University of Illinois, Urbana.

14. Types and degrees of human influence on biotic communities—William C. Van Deventer, University of Illinois, Urbana.
15. Instinct but a response to the law of habit (to be read by title)—Henry J. Reynolds, Chicago.
16. Temperature effects on the heart rate of double embryos of Fundulus (to be read by title)—Marie A. Hinrichs, Chicago.
17. Some studies on Guppyi *(Lebistes reticulatus)* (to be read by title)—Vernice Rathmell Wodrich, Bradford, Pennsylvania.
18. A synonymic catalogue of the reptiles of Illinois (to be read by title)—Walter L. Necker, Chicago Academy of Sciences, Chicago.

Entomology Division

19. The Pretarsus (Articularis) in Coleoptera—W. P. Hayes and W. P. Kearns, University of Illinois, Urbana.
20. Beyond the walls of mud-daubers' nests—Boyd B. Palmer, University of Illinois, Urbana.
21. Household insecticides that deserve wider recognition—C. L. Metcalf, University of Illinois, Urbana.
22. Notes on the flight and abundance of the seed-corn beetle—J. H. Bigger, State Natural History Survey, Jacksonville.
23. A sketch history of entomology in Illinois—Lee H. Townsend, University of Illinois, Urbana.
24. Beetles associated with the mound-building ant, *Formica ulkei* Emery—Orlando Park, University of Illinois, Urbana.
25. Codling moth hibernation on banded apple trees—S. C. Chandler, State Natural History Survey, Urbana.

ILLINOIS STATE ACADEMY OF SCIENCE

JUNIOR SECTION

HIGH SCHOOL SCIENCE AND CLUBS

A. E. Cockrum, West Chicago Community High School, *Chairman*

Carl Schatz, East St. Louis High School, *Local Chairman*

FRIDAY, MAY 5

8:00 a.m. Registration *(Display Room, Broadview Hotel)*.

8:00–11:00 a.m. Arrangement of exhibits *(Display Room)*. Scientific equipment exhibited by scientific companies.

11:45 a.m. Luncheon *(Broadview Hotel)*. 50 cents.

1:30–2:00 p.m. Annual business meeting of official delegates of Junior Section *(Auditorium, East St. Louis High School)*.

2:00 p.m. Formal initiation of new clubs—Granite City High School Science Club.
Music—East St. Louis Senior High School.
Address—L. A. Astell, Kankakee High School.
Physics demonstrations—C. T. Knipp, University of Illinois, Urbana.

3:45 p.m. Presentation of awards—Harry F. Ferguson, President, Illinois State Academy of Science.

4:00–6:00 p.m. Visit to Cahokia Indian Mounds, under the direction of a competent archeologist.

6:30 p.m. Annual banquet. *(Rathskeller, Broadview Hotel)*. 75 cents per plate. Program.

Plans for the evening are to be announced.

SATURDAY, MAY 6

9:00 a.m. Choice of inspection trips as listed under general program.

PROPOSED AMENDMENT TO THE CONSTITUTION

To be voted on at the Annual Business Meeting.

Change (indicated by *italics*) in the last paragraph of Article VIII relative to the distribution of publications, to read as follows:

"All paid up members shall receive gratis the current publication of the Academy, *except in case of an emergency.*"

NOTICE TO MEMBERS OF THE ACADEMY

The *Transactions* of the Academy have been published by the State, through the State Museum Division of the Department of Registration and Education, since 1918. Publication funds ($4000) were appropriated by the legislature for the biennium 1931-33, but because of the impoverished condition of the State Treasury, requisitions for printing Volume 25 have not been approved by the State Department of Finance. The Council authorized the Committee on Publications to arrange for publication of the small number (normally No. 1) and the preliminary program (normally No. 3) at Academy expense. If the appropriation should lapse before funds for printing the large number have been released, the Academy will endeavor to arrange for its publication or at least for the printing of abstracts of the papers presented at the Twenty-fifth Annual Meeting in Chicago, May, 1932.

Authors submitting papers at the Twenty-sixth Annual Meeting are urged to condense their articles as much as possible. If the present emergency continues, it may be impossible to allow more than four printed pages per article.

—*Committee on Publication.*

HEADQUARTERS OF THE ACADEMY

BROADVIEW HOTEL
EAST ST. LOUIS, ILLINOIS

Registration Desk in Hotel Lobby

Telegrams and other messages may be sent to individuals in care of Frank L. Eversull, Broadview Hotel, East St. Louis, Illinois, and called for at the registration desk.

Changes of schedule or program and other special announcements will be posted in the lobby at the registration desk.

Secure tickets for banquets and register for trips at the registration desk.

Junior Section Headquarters—Exhibit hall, corner of Fourth and Broadview, Broadview Hotel.

Housing facilities for out-of-town guests who wish to remain over Friday night will be furnished without cost for lodging, and the breakfast, if families so desire, through the courtesy of East St. Louis Senior High School pupils. Guests wishing these accommodations should communicate with Mr. Frank L. Eversull, East St. Louis Senior High School, East St. Louis, Illinois, *by May 1.* Hotel rates are noted below.

Hotel arrangements—All arrangements for the Academy of Science meeting should be made with the Broadview Hotel. Rates: single room $2.50; two in a room $1.50 each; three in a room $1.25 each.

Requests for further information may be addressed to the local committee on arrangements:

FRANK L. EVERSULL, *Chairman,*
East St. Louis Senior High School,
East St. Louis, Illinois.

INSTRUCTIONS TO AUTHORS

Authors intending to submit their papers for publication in the *Transactions* of the Academy must bring their manuscripts to the Section Meetings in *final form,* and immediately after presentation on the program, hand them to the section chairman who is responsible for their delivery to the Secretary. Drawings and figures should be carefully executed as the Academy can not meet the expense involved in redrafting. All illustrations should be numbered to correspond with text references. Authors are requested to follow carefully the instructions in the mimeographed pamphlet, "Instructions to Authors."

(Signed) H. R. WANLESS, *Secretary,*
University of Illinois, Urbana.

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ILLINOIS STATE ACADEMY OF SCIENCE

VOLUME 25 DECEMBER, 1932 NUMBER 2

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DEPARTMENT OF REGISTRATION AND EDUCATION
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SPRINGFIELD, ILLINOIS

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June, 1933

TRANSACTIONS OF THE ILLINOIS STATE ACADEMY OF SCIENCE

Volume 25 December, 1932 Number 2

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OFFICERS AND COMMITTEES FOR 1932-1933

President, HARRY F. FERGUSON, State Department of Public Health, Springfield.
First Vice-President, ADOLPH C. NOÉ, University of Chicago, Chicago.
Second Vice-President, FRANK L. EVERSULL, East St. Louis.
Secretary, HAROLD R. WANLESS, University of Illinois, Urbana.
Treasurer, GEORGE D. FULLER, University of Chicago, Chicago.
Librarian, ARTHUR S. COGGESHALL, State Museum, Springfield.
Editor, DOROTHY E. ROSE, State Geological Survey, Urbana.

The Council

The Council is composed of the PRESIDENT, First and Second Vice-Presidents, Secretary, Treasurer, Librarian, and the last two retiring presidents.

Committee on Membership

DON L. CARROLL, State Geological Survey, Urbana, *Chairman.*
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ALVIN R. CAHN, University of Illinois, Urbana.

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LOUIS A. ASTELL, Kankakee (Club Organization and Expansion).
ROSE CASSIDY, DesPlaines (Chemistry).
D. L. BARR, Mt. Pulaski (General Science).
ALLEN R. MOORE, Cicero (Physics).
P. K. HOUDEK, Robinson (Biology).
MABLE SPENCER, Granite City (News Letter).
ROSALIE M. PARR, University of Illinois, Urbana (University Representative).
O. D. FRANK, University of Chicago, Chicago (University Representative).
LYELL J. THOMAS, University of Illinois, Urbana (University Representative).

Committee on Publications

The PRESIDENT, the SECRETARY, and LYELL J. THOMAS, University of Illinois, Urbana.

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East St. Louis, May 5 and 6, 1933

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ECONOMICS—W. H. VOSKUIL, Illinois State Geological Survey, Urbana.

GEOGRAPHY—RUBY HARRIS, Eastern Illinois State Teachers College, Charleston.

GEOLOGY—J. EVERTS LAMAR, State Geological Survey, Urbana.

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MEDICINE AND PUBLIC HEALTH—FRANK J. JIRKA, Director, State Department of Public Health, Springfield.

PHYSICS—OTIS B. YOUNG, Southern Illinois State Normal University, Carbondale.

PSYCHOLOGY AND EDUCATION—RALPH W. PRINGLE, 401 West Mulberry Street, Normal.

ZOOLOGY—WILLIAM P. HAYES, University of Illinois, Urbana.

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* Deceased.

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PAPERS PRESENTED IN GENERAL SESSIONS AT THE TWENTY-FIFTH ANNUAL MEETING, CHICAGO

THE COMING OF MAN *

BY

FAY COOPER COLE, *University of Chicago, Chicago*

The speaker briefly reviewed the theory of evolution and the reasons which have led scientists to include man in this scheme. The testimony of embryology, of vestigial organs in living man, and of blood groupings, attest to the fact that man is related to the animal world and that his closest relations are to be found in the anthropoid apes.

It appears that man and the apes have a common ancestry far back in time. One is not evolved out of the other. A review of the geological evidence leads us to look for evidences of this common ancestor in the strata of Miocene times. The discovery of the Sivapithecus and Dryopithecus remains in India and Austria, and of the Taungs skull in Africa indicate a development toward man in those ancient strata.

Java furnishes the first being which appears to be so close to man and to the anthropoid apes as to constitute a missing link. The condition under which this discovery was made shows that we are here dealing with a being or beings which existed just at the end of Tertiary or the beginning of Quaternary time.

The recent finds of portions of ten individuals in early Quaternary cave deposits in China show conclusively that man had appeared there at least a half million years ago. These men—known as Sinanthropus—exhibit many characteristics of the lower anthropoids, yet fill the gap between the Java man and the later discoveries in Europe.

At this point the speaker reviewed the glaciations of Europe which serve as a time scale in reconstructing pre-history. The discovery of the Heidelberg jaw, of Piltdown man, and of the third interglacial skeletons near Ehringsdorf and Rome, were cited as proof of the early

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* Synopsis of the address by the retiring president, Shoreland Hotel, Friday evening, May 6, 1932.

occupancy of Europe. The thousands of stone utensils found in strata likewise attest to the growth and change of human culture. With the coming of the last great glaciation man was forced to make his home in the caves. Here he built his fire, here he brought the game he had killed, here he fashioned his tools, and here he buried his dead. The record of his home life is now so complete that we can describe his culture with assurance. The forty-two skulls and parts of skeletons recovered from the early period of cave occupancy, give us a definite picture of the race which practiced this culture. We are dealing with man, yet his skeleton reveals so many ape-like characters that the scientific world is convinced that we have here a definite step in human evolution.

With changes in climate, new types of plant and animal life invaded Europe from the East and South. With them came a new species of mankind, closely related to modern man. Here the presence of seventy-four skeletal remains and of thousands of implements, take us from the field of speculation into the realm of observed fact.

With the waning of the glaciers, the ancestors of the modern races invaded Europe bringing with them the beginnings of the New Stone Age.

The balance of the lecture dealt with the development of culture in the Near East and its spread to modern Europe. There have been periods of set-back, but a review of this long story of the past has shown steady development toward modern man and our present-day civilization.

NATIONAL FOREST MOVEMENT IN ILLINOIS*

BY

L. E. Sawyer, *Extension Forester, Illinois State Natural History Survey, Urbana*

Introduction

Interest in securing the establishment of National Forest purchase units in Illinois was brought out at the first meeting of the Central States Forestry Congress in Indianapolis on December 3, 4, and 5, 1930, where Mr. E. W. Tinker, Regional Forester of the United States Forest Service, mentioned having received requests as early as May 19, 1930, for information on the possibility of the establishment of National forests in Illinois. Upon being assured that sufficient acreage was available, Mr. Tinker consented to send one of the Acquisition men to make a preliminary examination of the areas.

Mr. William L. Barker, Jr., of the United States Forest Service, spent a week in February, 1931, with Mr. E. A. Norton, Assistant Chief in Soil Survey Mapping, and the writer, in making a preliminary examination of possible suitable areas. In addition to covering the ground as thoroughly as possible, Soil Survey maps showing the types of soils, and State Natural History Survey Maps showing the location of stands and types of timber, were used to locate the boundaries of the suitable areas. The offices of the tax collectors in the various counties were visited, and all available information on tax delinquency was secured. Before leaving the State, Mr. Barker interviewed Mr. R. F. Bradford, Director, and Mr. E. E. Duvall, Assistant Director, of the Department of Conservation, who voiced their approval of the movement.

As a result of the examination, Mr. Barker submitted a preliminary report dated March 6, 1931, in which he recommended the establishment of two purchase units having a total area of 936.3 square miles, provided the State passed a satisfactory Enabling Act. On March 4, 1931, Mr. W. Z. Black, a member of the General Assembly from Champaign, introduced House Bill 405, "an Act in relation to the acquisition of lands in the State of Illinois by the United States, for establishing, consolidating, and extending National Forests." On March 26, Dr. T. H. Frison, Chief of the State Natural History Survey, Mr. Tinker, Mr. Norton, and the writer appeared before the Agricultural Committee of the House in behalf of this bill. On April 23, the bill was passed by the House without opposition. On April 28, Dr. Frison, Mr. Norton, and the writer appeared before the Forestry,

* Presented before the General Session at the Twenty-fifth Annual Meeting of the Illinois State Academy of Science, Mandel Hall, University of Chicago, May 6, 1932.

Fish, and Game Committee of the Senate, to sponsor the bill which was passed without opposition by the Senate on May 21. This bill, which was an official invitation from the State of Illinois to the Federal Government to acquire lands for National Forests within the state, became a law when it was signed by Governor Emmerson on June 18.

Proposed National Forest Purchase Units

Location.—The areas which were examined and recommended for purchase are in the southern part of the State. The western one, in Jackson, Union, and Alexander counties, is referred to as the Illini Unit. The eastern, in Pope, Hardin, Gallatin, and Saline counties, is referred to as the Shawnee Unit (Fig. 1).

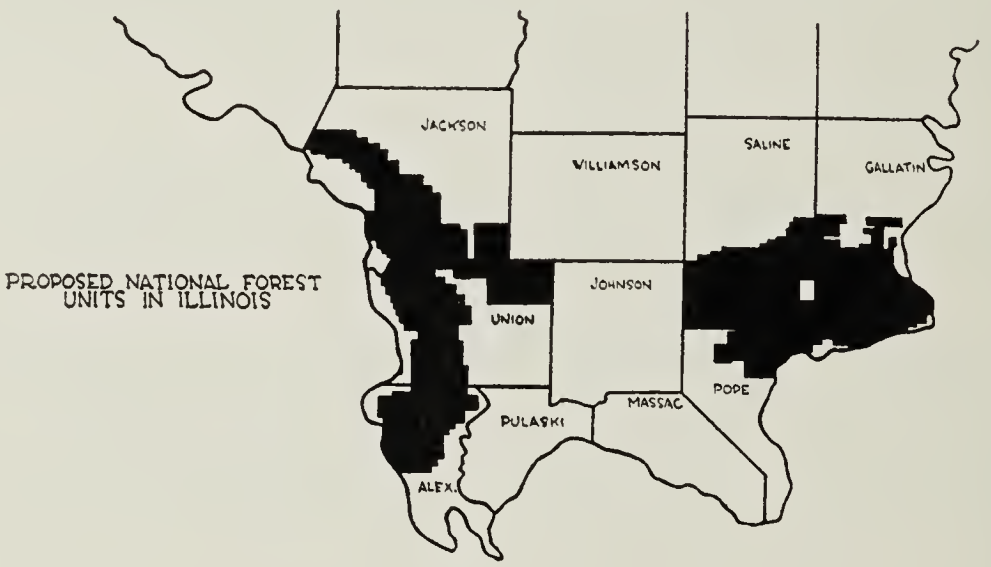

Fig. 1

Topography and soil.—Mr. Norton has described these areas as follows:

"The topography of the land area included in the two proposed National Forest Purchase Units in Southern Illinois is of a general rough, broken, and hilly nature. The region was uplifted in post-Pennsylvanian times and has been exposed to erosion ever since. Maximum difference in altitude is about 600 feet, and there are many precipitous, rocky slopes. About 75 per cent of the area lies on slopes steeper than 15 per cent and is subject to destructive erosion even under a grass cover. Ten per cent of the area is bottomland, subject to frequent overflow. The creek bottomlands are narrow, quite sandy, and inaccessible for cropping. The soils in the large river bottomlands are not only subject to frequent overflow but have a heavy, impervious subsoil which makes underdrainage impractical. The remaining 15 per cent of the area lies on slopes which vary from 3 per cent to 15 per cent and is subject to harmful erosion under cultivation. Most of this has been cultivated at one time or another, but fully two-thirds is now abandoned, either destroyed by erosion or worn out by continual cropping.

"The soils of the area were formed from wind-blown material, known as loess. It was deposited at two intervals during the glacial period on the original rough and broken surface. The earliest deposit was weathered before the latter was deposited, so that when erosion removes the upper layer it exposes the older, unproductive material below. The soils developed under conditions of good drainage and a low water-table and consequently were quickly leached, so that much of the plant food which they originally contained was readily removed. Only a small supply of plant food, held there

by the forest cover, remained in the soils when it was cleared. This was soon washed away by erosion or cropped off by man, and the soil became impoverished.

"Crop yields obtained from two experimental fields operated by the University of Illinois located in that area indicate the worn-out condition of the land. It should be noted that these fields were located on the smoother type of land. At Elizabethtown, in Hardin county, the average yields on untreated land were as follows:

	Crops	Bushels per acre
Wheat	16	3.9
Corn	11	11.6
Soybeans	4	2.7
Mixed hay	6	.17 (tons per acre)

"At Vienna, in Johnson County, the average yields on untreated land were as follows:

	Crops	Bushels per acre
Wheat	7	4.6
Corn	7	14.1
Clover hay	3	.21 (tons per acre)

"The Vienna field has been discontinued, the conclusion being reached that this land could not, under ordinary grain cropping systems of farming, be made profitable. Treatments at the Elizabethtown field have increased the yields of grain, but seldom was the increase large enough to pay for the cost of treatment.

"The average yields of three crops in the seven counties included in the proposed purchase units, as given by the Crop Reporting Service of the United States Department of Agriculture, are: corn, 26 bushels; wheat, 12 bushels; and oats, 25 bushels per acre. These figures are considerably higher than those from the experimental fields, indicating that the farm land outside the proposed units is more productive than that within.

"The land in this portion of the state has been farmed from 80 to 100 years or more, without much care given to its fertility. Most of it is now worn out because of continual cropping. The cost of reclaiming this worn-out soil for cropping is prohibitive, and much of it is returning to its original vegetative cover by being abandoned and reforested naturally."

Original timbered area.—The seven counties in which it is proposed to establish the National Forest Purchase Units were once completely covered with timber, having a total area of 2,131.18 square miles. Through clearing for agricultural purposes and indiscriminate cutting, the forest area has been reduced to 619.2 square miles, or 29.5 per cent of the original timbered area. According to figures prepared by the Soil Survey, these counties contain an area of 1,146 square miles of land so rough that it will not yield a profit under present systems of management, and 233 square miles of flat land having an impervious subsoil.

Present timbered area.—Although the timbered area of the counties in which the two units lie has been reduced to 29.5 per cent, the units themselves are located in the more heavily timbered parts of these counties. As a result, the Illini Unit is approximately 70 per cent timbered and the Shawnee Unit at least 50 per cent.

Fire problem.—The fire problem on this area is acute. The only portion that can be considered as having adequate fire protection is the 5.15 square miles now held as a State forest. Most of the rest burns periodically. Many portions have been burned over so repeatedly that

they are now practically unproductive. The trees as a rule are fire-scarred, and many of them have been burned to such an extent that they no longer contain any merchantable material. According to the Third Report on a Forest Survey of Illinois, published in March, 1926:

> **"Forest fires do more damage in this region than anywhere else in the state. An examination of 33 sections in this region in 1921 disclosed that 12 had been partially or completely burned over in the past three years. The reproduction is naturally excellent in this region but fires must be controlled before well-stocked stands can be realized. These rough and broken uplands originally supported a forest of black and white oak, hickory, red oak, tulip, beech, hard maple, black walnut, ash, cucumber-tree, butternut, basswood, elm, Kentucky coffee-tree, black and red gum and mulberry. Customarily, the oaks predominate, yet it is not unusual to find nearly pure stands of beech in the draws and on lower slopes."**

Timber stocks.—The original stands contained more than 4,500 board feet per acre, while the existing timbered areas have been so mistreated that according to "a tally of all trees 6 inches and over in diameter on 181.66 acres, they now contain an average of 2,699 board feet per acre and are only one-third stocked."

In recent years this region has been heavily drawn upon for saw logs, ties, and mine timbers, and virtually every species is utilized down to very low diameters. As a consequence, the forests in this region are over-cut, growth does not equal the cut, and the amount of growing timber per acre steadily diminishes. The average acre supports only 37 trees with a volume of 886 cubic feet. The same acre, if fully stocked with trees of the sizes present, should have 108 trees with a total volume of 2,586 cubic feet of timber, or three times the present volume.

The soil of this general region is a productive timber soil and is reputed to produce some of the best-textured white oak in the country. Even under the present conditions of mismanagement, 34 sample plots show that at 80 years of age the trees attain an average height of 73 feet and a diameter breast high of 12.5 inches, and they increase in volume at the rate of 155 board-feet per acre each year. These same stands, if fully stocked and given the proper attention, should be capable of producing not less than an average of 250 board-feet per acre each year—which is considered a good yield.

Illini unit soils.—The soils in the western counties are classified by the Soil Survey into from eleven to thirty types per county. These naturally divide themselves into three groups of sufficient difference for land acquisition. They are (1) bottomland, (2) stony slopes, and (3) upland. Certain areas in the bottomland and upland groups are suitable for farm crops, and these areas are put in a fourth classification, called "Farm Soils."

The Illini unit consists of 481 square miles. Nineteen per cent of this area, or 92.09 square miles is classified as "farm soil"; 75.61 square miles as bottomland that is unfit for agricultural purposes; 5.7

square miles as stony slopes; and 307.6 square miles as upland that is too rough to be cultivated. Most of the "farm soil" is in irregular, more or less inaccessible patches in the broken upland, and crop production and marketing would be expensive, not over 5 per cent of the area being in cultivation at the present time.

Shawnee unit soils.—The Shawnee Unit has a total area of 455.3 square miles, of which 25.1 square miles, or five and one-half per cent, is classified as "farm soil", 18.87 square miles as bottomland unsuited to the production of agricultural crops, 78.08 square miles as stony slopes, and 333.2 square miles as upland that is too rough to be farmed to good advantage with modern machinery. The "farm soil" in this unit is also in small irregular patches that are even more widely scattered than in the Illini Unit.

Public Support of Proposed National Forests

The passage of the enabling act was not all that was necessary to secure the consideration of the units by the National Forest Reservation Commission, as it is the policy of the United States Forest Service not to purchase land in a county unless the people who live there give evidence of their approval. The next step, then, was to determine if the people in the counties involved would be favorable to the establishment of the units. The plans were briefly discussed with the Farm Adviser at Harrisburg, who in turn discussed them with members of the Harrisburg Kiwanis Club. These men called a joint meet at Golconda, May 27, 1931, and requested the writer to attend and explain the entire movement. That evening's meeting resulted in the organization of the Illinois Ozark Reforestation Unit, which has been instrumental in presenting the plan to the civic clubs and other organizations in the Shawnee Unit. A similar program was followed in the Illini Unit.

Meetings were called at centrally located points throughout the units, and the plan was outlined to those attending. The methods of land appraisal and purchase were explained, and the handling of the areas, once they were established, was outlined. One question which was always brought up was, "What will be paid for land?" With the figures given in the annual report of the National Forest Reservation Commission as a basis, the possible purchase prices were discussed. At a meeting in Elizabethtown, Hardin County, on June 1, 1931, when prices of from three to five dollars per acre were mentioned, a man from Karbers Ridge, in the north part of that county, said that it would be too much for some of the land. This was found to be the prevailing attitude throughout the two units, and the general opinion was that all of the land that would be required could be purchased at whatever price the Forest Service considered fair.

Evidence of local approval took the form of petitions addressed to the National Forest Reservation Commission. The county organ-

izations sponsoring the establishment of the units requested petitions first from the county commissioners or boards of supervisors of the various counties. Without exception these men readily signed the petitions, for they said that the land was not bringing in enough revenue each year to pay the cost of keeping up the roads and schools and that the cash refund of 25 per cent of the gross receipts from the Forest Service would eventually bring in far more than the taxes had ever done.

As a result of the action of the Illinois Ozark Reforestation Unit, thirty-three petitions requesting the establishment of the Shawnee Unit have been forwarded to the National Forest Reservation Commission, copies of them having been sent to the Governor of Illinois, Director of Conservation, and to the Regional Forester. Included in these petitions are four from the county supervisors or commissioners, eight from village or city councils, eighteen from civic clubs or other organizations and three from business concerns that are vitally interested in the welfare of that section of the state.

At the present time the success or failure of the whole movement lies in the hands of the National Forest Reservation Commission, which consists of the Secretary of Agriculture, the Secretary of War, the Secretary of the Interior, two Senators and two Representatives. The action that these men take on the petitions will depend largely upon the recommendations they receive from the Chief Forester of the United States Forest Service. The indications are that we cannot be sure of having his recommendations for the establishment of the units. From his standpoint this would be a radical departure from the policies approved by Congress and thus far pursued by the Department of Agriculture and the Commission. The Forest Service offers the argument that acquiring lands for National Forests in Illinois would mean extending the Federal ownership into new regions for purposes not advocated by the Department or contemplated by the purchase legislation. Let us examine this argument.

The Weeks Law, as enacted by Congress March 1, 1911, authorizes the purchase of land for National Forests on the watersheds of navigable streams. The Clarke-McNary Law, as enacted by Congress June 7, 1924, provides for the purchase of lands for National Forests that are primarily adapted to the production of timber. The proposed national forest purchase units in Illinois meet the requirements of both of these laws. The one on the eastern side of the state lies on the watershed of the Ohio and Wabash rivers, and the one on the western side of the state on the watershed of Mississippi River. These streams, being easily of as much importance to the welfare of the United States as any of the streams on the Eastern Seaboard whose watersheds are now being protected by National Forests, should be entitled to the same protection. After once seeing the areas that have been approved and

recommended for the establishment of the two purchase units, an observant person could not conscientiously say that the areas as a whole were suitable for anything except the production of timber.

The United States Forest Service has made the statement that its plan is to purchase 2,500,000 acres, in units of 100,000 acres or more, in the logged-off regions of the Lake States and an equal area in the cut-over pine lands of the South. These units of 100,000 acres or more are to serve as demonstrations, which might be followed by the states and private individuals in the management of similar lands. This program means the purchase of about 5 per cent of the logged-off land and would leave about 95 per cent to the states and private owners. Should two units of 100,000 acres each be established in southern Illinois, it would be approximately 3 per cent of the area of land in the southern 36 counties that is now sub-marginal for grain production. This would be less than 2 per cent of the total land area in the state that is better suited to the production of timber than any other crop. Considering the surrounding states which have a land problem similar to Illinois and in which the two units would serve as demonstrations of proper forestry practices, the two proposed units of 600,000 acres would be less than one-half of one per cent of the total area that should be in timber in these states.

The establishment of the two proposed purchase units in Illinois would represent a solution to one of the problems of the Central States Forest Experiment Station. The report of that station for 1930-31 includes the following statement: "No Federally owned land is available to the Station, except the National Forest now being purchased in Kentucky and the National Forest already organized in northern Arkansas. The Station wishes to take this opportunity to announce the pressing necessity for the establishment of more working centers. Permanent work cannot be undertaken until such working centers are established." Forestry experimental work necessarily requires a long period of time and cannot be undertaken unless the ownership, management, and protection of the land are assured for the required period. Federal ownership of the two proposed units in Illinois would assure the Central States Forest Experiment Station of the permanent working centers desired.

Our forestry problem in Illinois is commonly referred to as a farm woodlot problem, and that is true for the majority of the state, but in the areas in which National Forest purchase units are recommended the problem never was nor is it now a farm woodlot problem. This area is, as a whole, unsuited to agricultural use (grain crops or hay) and for that reason is not different in this respect from the semi-mountainous regions or the pine lands of the Lake States and the South. Illinois is not receiving any part of the federal funds appropriated for the protection of forests from destruction by fire, for the Forest

Service has removed Illinois from the list of states that were receiving federal cooperation for fire protection purposes. At the present time Illinois has no cooperative nursery whereby it can take advantage of the federal money available for the production of nursery stock for reforestation purposes.

The establishment of one or more National Forest Purchase Units in Illinois would be of untold value to the state and to the central hardwoods region. They would serve as demonstrations of correct forestry practices. In addition, the purchase of this land would benefit many of the people living within the proposed units and the counties within which the units lie. Many of the people living back in the hills in the proposed units have lived there all of their lives. The productive capacity of the land has decreased to a point where they can no longer eke out an existence, and they have no funds with which to go elsewhere. The purchase of this land by the Federal Government would enable them to leave their worn-out lands and migrate to a more prosperous section of the state.

Abandonment of title by tax delinquency is increasing at an alarming rate. At the time the preliminary examination of the proposed areas was made in February, 1931, the total area of land forfeited for the non-payment of taxes in the counties in which the units are located was 25,320 acres, distributed among them as follows: Jackson, 2,900 acres; Union, 3,000 acres; Alexander, 9,200 acres; Gallatin, 8,900 acres; Pope, 600 acres; and Saline, 640 acres. These figures are only for the portions of the counties included in the proposed purchase units and not for the counties as a whole. While figures from the 1931 tax sales are not available for all of the counties, those available are very conclusive evidence that the amount of forfeitures is increasing. In Alexander County alone, in the portion included in the proposed unit, the area of land forfeited for the non-payment of taxes in 1931 had increased to 24,469 acres, an increase of 15,269 acres in one year. In Jackson County the forfeitures increased from 2,900 acres in 1930 to 12,003 acres in 1931.

Unless the fire hazard is extremely great, National Forests are open to the public for recreational purposes as long as the Forest Service regulations are obeyed. Areas suitable for summer home sites can be leased at a nominal charge, agricultural lands can be farmed under a special use permit, and except for areas that may be designated as State or Federal game preserves, National Forests are open to the public as hunting and fishing grounds. More than thirty million people registered as visitors to National Forests in 1931. If the purchase units are established in southern Illinois, they will furnish recreational areas for thousands of Illinois people.

With the large reduction being made in the Federal appropriations for acquisition work, it would, of course, be impossible for the pur-

chase of lands in these proposed units to begin at once, but when the general economic conditions of the country return to normal and money is again made available for the acquisition of National Forest lands, Illinois should have one or two units already approved by the National Forest Reservation Commission, in which the purchasing of land could begin at once. The lands recommended for purchase do lie on the watersheds of navigable streams and are better suited to the production of timber than any other crop. The conditions existing on the proposed purchase units are similar to those in Kentucky and Arkansas where units are already established. The establishment of these units would not be a departure from the policies of the Department of Agriculture and the National Forest Reservation Commission if the lands already purchased in Arkansas and those being purchased in Kentucky fulfill the specifications as interpreted by those bodies. Illinois can have National Forests if every interested individual and organization will make it a point to bring the matter to the attention of senators and representatives and other influential men in Washington. Just demands, coming from a state that pays as large a percentage of the Federal taxes as does Illinois, cannot long be ignored, and Illinois will have the National Forests to which she is entitled.

TWENTY-FIVE YEARS OF THE ILLINOIS STATE ACADEMY OF SCIENCE

BY

M. M. Leighton, *Chief, Illinois State Geological Survey*

Introduction

Twenty-five years ago a representative and distinguished group of scientists, teachers, and laymen met in the Senate Chamber of our Capitol at Springfield and organized the Illinois State Academy of Science. To be exact the date of this notable event was December 7, 1907. The present annual meeting, therefore, rounds out twenty-five years of history and it is fitting to take note of the Academy's development and success achieved.

The present Academy was preceded by two state natural history societies. The first was founded in 1858 at a meeting of the State Teacher's Association at Bloomington, upon the proposal of Dr. Cyrus Thomas, an entomologist. It was formed primarily as a natural history survey in the old sense of an accumulation of museum specimens and a descriptive record of the state's zoology, botany, and paleontology. It held ten annual meetings and then dissolved, due to financial difficulties, transferring its museum collection to the State. It did much to stimulate interest in natural history and research, and hastened the introduction of the sciences into the public schools.

The second society was formed eleven years later, in 1879, as an outgrowth of a summer school of natural history at the State Normal School. Its first president was A. H. Worthen, State Geologist, and its first secretary, S. A. Forbes. This was a period of the return to nature in the study of science, and field meetings were held annually as well as program meetings in different parts of the State. The physical and mathematical sciences were not included on the ground that their interests were considerably removed from the natural sciences. The Society also had no publication. Six years after its founding, with decline in membership and interest, and no election of officers, the society passed out of existence.

The Chicago Academy of Sciences was founded in 1857, fifty years before the State Academy was organized. It held its seventy-fifth annual meeting less than one month ago, on April 11th.

The Organization Meeting

It is apparent from the published record that the birth of the Academy was of a distinguished character. Among the men participating in its organization or who served as charter members, were Hopkins from Agriculture; Starr from Anthropology; Burrill, Coulter (John

M.) and Cowles from Botany; Bartow, Noyes, Parr, and Smith (Alexander) from Chemistry; Chamberlin, Bain, Bayley, Grant, Udden, Weller, and Williston from Geology; Townsend from Mathematics; Bain (Walter G.) from Medicine; Michelson and Carman from Physics; and Forbes and F. C. Baker from Zoology.

H. Foster Bain, then State Geologist, and A. R. Crook, Curator of the State Museum, were, it appears, most active in bringing about the organization. Crook called the organization meeting to order, U. S. Grant was elected temporary chairman, and Secretary of State James A. Rose, gave the address of welcome. It is an interesting sidelight to know that H. F. Bain had arranged for Governor Deneen to welcome the prospective members but he was called away and Rose took on the job. He had known nothing about the matter until Bain appeared in his office and asked him to substitute for the Governor. He promptly accepted, and after asking Bain a few questions on the way over to the meeting, he made a very appropriate address concerning the desirability of effecting an organization of scientific men along lines already followed by men of many professions and callings in the State.

Professor T. C. Chamberlin was made the first president and was re-elected the following year. He is the only man to whom this distinction has been given. We appropriately do him honor by holding our twenty-fifth meeting at the University of Chicago, where he made his great contributions to the earth sciences.

The first Vice-President was Henry Crew of Northwestern University; Secretary, A. R. Crook, State Museum, who served for five terms and later became Librarian; Treasurer, J. C. Hessler, James Millikin University; Third member of Publication Committee, H. F. Bain, State Geological Survey.

The Constitution of the Academy

The Constitution of the Academy was shaped by a committee composed of men from various lines of science and from various institutions: S. W. Williston, University of Chicago, Chairman; W. A. Noyes, University of Illinois; C. B. Atwell, Northwestern University; T. C. Chamberlin, University of Chicago; S. A. Forbes, University of Illinois; A. R. Crook, State Museum; F. L. Charles, Northern Illinois State Normal; H. V. Neal, Knox College; and B. B. James, Millikin University.

From this broad representation, it will be seen that in the very beginning there was established the principle of statewide organization and participation, which principle has been followed down to the present.

The Constitution was made simple, broad, and definite. In its fundamental provisions it has remained intact, only minor amendments being made during the past twenty-five years.

Objects and Activities of the Academy

The objects of the Academy were made to embrace three points: (1) the promotion of scientific research; (2) the diffusion of scientific knowledge, (3) the unification of the scientific interests of the State. The extent to which these objects have been attained and the development of new trends will be apparent from the following:

The Promotion of Scientific Research and Diffusion of Scientific Knowledge

Growth in membership.—The membership of the organization the first year numbered 114. With the exception of a few years there has been a steady growth, the membership tripling in the first five years, not increasing the second five, decreasing during the World War but nearly doubling again by the close of the third five-year period, and nearly doubling again during the last ten years, until now the total membership is past the 1100 mark. Nearly ten per cent of these are life members. This record, it would seem, definitely records an increased interest in scientific research, credit for which the Academy is warranted in claiming its share, along with other organizations and institutions. This is also borne out by the increased number of papers presented.

Presentation of papers.—At the first meeting nine papers were presented; at the second meeting this number was doubled. During the first five years a total of 81 were given; the second five years, 128; the third five years, 174; the fourth five years, 314; and the last five years, 466.

In addition to individual papers, symposia have been held on the following general subjects: The outlook for young men in the various sciences; the scientific activities of the State; the relation of pure and applied sciences to the progress of knowledge and of practical affairs; the rôle of science in modern civilization; science and reconstruction. Symposia have also been held on the following specific subjects: The atmosphere; radioactivity; colloids; conservation; science of sanitation; water supply; public health problems; the present status of evolution; and archaeology in Illinois.

Increased scope of activities.—Although the constitution of the Academy as first drawn recognized the possible division into sections, the general concensus of opinion at that time was that too minute subdivision would be at the expense of the broader influences of the Academy. Until 1915 all papers were presented and discussed before the entire assembly.

The increasing length of the program and specialization of interest finally overcame other arguments and in 1915, in addition to the general sessions, two sectional meetings were held simultaneously, one covering botany, bacteriology, and chemistry, and the other zoology,

entomology, and geology. In 1916, five sections were organized: botany and bacteriology; zoology and medicine; physics and engineering; chemistry and agriculture; geology and geography.

In 1920, the following six sections supplemented the former five: medicine and public health; biology and agriculture; geology and geography; chemistry and physics; mathematics and allied sciences; education and psychology.

In 1929, geology and geography organized separate sections, and in 1930, biology and agriculture divided into sections in botany and zoology, and a new section in agriculture is being organized. A new field, that of economics, was adopted in 1931 and a section organized. This year, a section in anthropology is being organized.

Promotion of research by State scientific surveys.—The Academy has lent its moral support to the research work of the State scientific surveys on the development and conservation of the natural resources of Illinois. This research work is placed by legislative enactment under a Board composed primarily of scientists—experts in the fields of geology, chemistry, botany, forestry, and engineering—and also including the President of the University of Illinois as ex-officio member and the Director of the Department of Registration and Education as ex-officio Chairman. The majority of the members of this board and of the Surveys' scientific staffs are members of this Academy, they have been called into the counsels of the Academy, and a number of them have served as President. The aims of the surveys are in line with those of the Academy, and some of their work has been furthered by appropriate endorsements.

Other activities of the Academy in behalf of science and human welfare have included (1) the endorsing of legislation, in 1913, to enforce the registration of births and deaths in Illinois; (2) urging suitable provision in 1915 for housing the State Museum; (3) recommending the adoption of the centigrade scale in government publications, 1916; (4) urging duty-free importation of scientific apparatus for use in educational institutions, 1922; (5) advocating the adoption of the metric system of weights and measures, 1926; (6) urging the favorable consideration of bills for state parks and forests, 1923; (7) recommending repeatedly reformatory action by the State Legislature concerning the practice of polluting the streams and rivers of Illinois, 1924, 1925, 1926, 1927-29; (7) endorsing the proposed establishment of a Department of Conservation, 1925; (9) endorsing the proposed organization of a National Forest in Illinois; (10) recommending the establishment by Congress of financial awards for most noteworthy and valuable inventions and discoveries; and other worthy actions.

Publications.—Annual volumes have been issued containing most of the papers presented at the meetings, totaling more than 1100. Naturally not all of these papers are of equal quality, but many of them

have served not only the interests of so-called pure science in this State and the world at large, but applied science as well.

The expense of publishing was at once a large item of expense, and because the Academy was devoted to the promotion of the scientific interests of the State, a request was made for a State appropriation for publication of the proceedings at the second annual meeting. The response of the legislature for a time was uncertain from year to year, but in 1919 the Academy became officially affiliated with the State Museum, and an appropriation for printing became an item in the Museum's budget. This has continued to the present time.

For many years the editing of the Transactions was included with the duties of the Secretary, but in 1929 the burden became too great and the office of Editor was established. During the past year the efforts to provide prompt publication have been satisfactorily met.

Unification of Scientific Interests in the State

Affiliations with other scientific organizations.—At the organization meeting, C. E. M. Fischer of the College of Physicians and Surgeons called attention to the desirability of affiliating with various existing organizations and this was provided for in the Constitution. In 1919, the Academy became affiliated with the American Association for the Advancement of Science, in 1923 with the Normal Science Club of Illinois State Normal University and the Rockford Nature Study Society; in 1924 with the Illinois Nature Study Society of Elgin; in 1925 with the Chicago Academy of Science, and the University of Chicago chapter and the University of Illinois chapter of Sigma Xi; in 1926 with the Southern Illinois Science Club of Southern Illinois State Teachers College; in 1927 with the Chicago Nature Study Club; in 1928 with the Illinois Association of Biology Teachers and the Illinois Association of Chemistry Teachers; in 1929 with the Sigma Zeta Society of Shurtleff College and the Alpha Eta chapter of Theta Chi Delta of Carthage College; in 1930 with the Peoria Academy of Science. The Academy is also affiliated with the Botany Club of Joliet, but the writer does not have information as to the date.

Organization of the Junior Academy of Science.—The sentiment was expressed at the organization meeting that the high schools should be in touch with the Academy. In 1910, a committee on assistance of the Academy to high schools in science teaching was appointed, in 1911 a committee to investigate the status of high schools as to science teaching, in 1912 a committee on publication of State Academy leaflets on high school science, in 1917 a committee on junior membership for high school students, in 1918 a committee to study the question of improvement of high school courses in botany, zoology, biology, and physiology and in 1919 a committee on high school science and clubs, which has been made a standing committee.

In 1928, this committee, acting under the chairmanship of Miss Aleta McEvoy of Rockford High School and with the active assistance of Mr. Louis Astell of West Chicago High School, organized the Junior Academy of Science with its own constitution but sponsored by the Senior Academy. Under this plan the Junior Section is composed of high school science clubs which undertake project studies in science by the student members under the direction of science instructors. This plan is proving to be highly successful, as shown by the fact that the high school clubs increased from 11 in 1929 to 31 in 1930 and to 55 in 1931; with a total of more than 2,000 students. This splendid record was made under the chairmanship of Miss McEvoy during 1929 and 1930 and then under Miss Mabel Spencer of the Granite City high school, during 1931.

The state officers of the Junior Section are chosen from the student members of the affiliated high school clubs. The annual meetings are held in part in conjunction with the Senior Academy and in part independently. In this way they have opportunity to hear scientists of note, also compete for state awards in exhibits, posters, and project work, and to become informed regarding the most effective club programs. A special insignia has been designed for the Junior Section members by Miss Gretchen Court of West Chicago. The prizes have been generously donated by the Illinois Association of Chemistry Teachers and various industrial firms and individuals.

This science club movement on a state-wide basis is pioneer work on the part of the Senior Academy, and it appears to have very large possibilities. May the excellent start already made continue until all of the standard high schools of the State organize science clubs and their members become members of the Junior Section.

Coördination of ecological work.—In a paper presented at the first annual meeting, Frank C. Baker, whose untiring work in ecology has continued to the present day and who is our first Vice-President for the current year, called attention to the need of "a complete biological survey of the State, of such an exhaustive character as to leave no part of the area unknown."

Six months later, at a Council meeting held in Chicago, a committee on ecological survey was appointed, consisting of S. A. Forbes, Chairman, F. C. Baker, H. C. Cowles, H. A. Gleason and F. T. L. Haukinson. This committee, with changes in personnel, has been active throughout most of the life of the Academy. Space does not afford an adequate statement of its work, but this committee has sought to stimulate ecological projects in various parts of the State, to promote methods of ecological study, to encourage conferences among the workers, to relate the work to that which is being carried on by the Natural History Survey, and to report the results at the annual meetings. In 1927 the Committee undertook also the preparation of a bibliography of ecological literature on Illinois flora and fauna, which is now complete.

General Observations

The period through which the Academy has passed has been marked by perhaps the greatest advances made in science during the world's history and by a corresponding change in our industrial and social life. The one has produced the other. In this great advancement the Illinois State Academy of Science has participated and contributed its share. But its work has only started. We are entering a new order which calls for the Academy to bear its portion of responsibility—an order which will demand a change from extreme specialization in science to combined specialization and unified effort to solve problems which one science alone cannot solve, a change also which will demand a greater influence on the part of the scientific group of the nation on the solution of its great social, political and ethical problems.

In the words of our distinguished discoverer of Illinium, "Hats off to the accomplishments of the past; coats off to the accomplishments of the future".

MINUTES OF MEETINGS OF THE 1932-1933 COUNCIL

First Meeting

The meeting was called to order by President Ferguson at 8:00 a. m., May 7th, in a conference room at the University of Chicago. The members present were G. D. Fuller, F. R. Jelliff, A. C. Noé, Fay-Cooper Cole, and H. R. Wanless. The minutes of the last meeting of the old council were read and approved.

It was voted that the present Committee on High School Science and Clubs should be continued until the next meeting of the council, and that a representative of that committee be invited to attend the next council meeting.

The following were chosen as a committee on Ecological Survey for the ensuing year: A. G. Vestal, Chairman, W. G. Waterman, V. O. Graham, V. E. Shelford, W. C. Allee, L. E. Sawyer, C. E. Montgomery, John Voss and Mary M. Steagall.

The following were chosen as a committee on Conservation: H. C. Cowles, Chairman, M. M. Leighton, W. H. Haas, Jens Jensen, Paul Houdek, R. B. Miller, and F. M. Fryxell.

Members chosen for the Committee on Legislation and Finance were Don W. Deal, R. C. Lanphier, and F. W. Aldrich. The Chairman of this committee was not selected.

Miss Dorothy E. Rose was reelected Editor of the Transactions for the year 1932-33.

The present committee on State Hall of Fame was retained for the ensuing year. This committee consists of M. M. Leighton, Chairman, W. A. Noyes, H. J. Van Cleave, Henry C. Cowles, and U. S. Grant.*

Mr. A. C. Walton was continued as delegate to the Academy conference of the American Association for the Advancement of Science, for the December meeting at Atlantic City. Mr. V. O. Graham was reelected delegate to the Conservation Council of Chicago.

It was voted that the Committee on Publications be authorized to secure the publication of No. 4, Vol. 24, before July 1st if possible, or as soon thereafter as possible. It was voted to request Dr. W. A. Noyes to prepare a brief memorial article about the late Prof. S. W. Parr, for publication in the Transactions. The Secretary was authorized to notify new members of their election in the usual way. It was voted that the Secretary be authorized to expend the necessary money to execute this office, not to exceed $100.00. It was voted that the Editor be authorized to incur the necessary expenses, not to exceed $25.00.

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* Deceased.

A committee, consisting of the President, the Secretary and Dr. M. M. Leighton, was appointed to consider the choice of a place for the next annual meeting.

The meeting was adjourned at 9:50 a. m.

(Signed) H. R. Wanless, *Secretary*

Second Meeting

The second meeting of the Council was called to order at 1:00 p. m., December 10, 1932, at the Quadrangle Club, University of Chicago, with President Ferguson in the chair. The members present were G. D. Fuller, A. C. Noé, and H. R. Wanless. Mr. A. E. Cockrum, Chairman of the Junior Section, also attended this meeting.

The minutes of the last meeting were read and approved. The name of A. R. Cahn, Urbana, was added to the membership on the Committee on Legislation and Finance. A committee, consisting of the President, Secretary and Dr. M. M. Leighton, past-President, were authorized to add to this committee such names as may be desirable.

The Council voted to appoint as the Committee on High School Science and Clubs, the following, who had been recommended by Mr. Cockrum: Louis A. Astell, Kankakee (Club Organization and Expansion); Miss Rose Cassidy, Des Plaines (Chemistry); D. L. Barr, Mt. Pulaski (General Science); Allen R. Moore, Cicero (Physics); P. K. Houdek, Robinson (Biology); Miss Mable Spencer, Granite City (News Letter); Miss Rosalie M. Parr, Urbana (University representative); O. D. Frank, Chicago (University representative); Lyell J. Thomas, Urbana (University representative); A. E. Cockrum, West Chicago (Chairman).

Two other persons, to take charge of advertising and the exhibits at the annual meeting, will be selected by Mr. Cockrum and added to the committee later. The organization of this year's committee is planned in such a way as to distribute more of the work of the Committee among its members and put less load upon the Chairman than in former years.

The Secretary reported for a committee appointed to consider the place of meeting for the 1933 annual convention, that favorable contacts had been made with school and municipal authorities in East St. Louis. It was voted to hold the 26th annual meeting at East St. Louis May 5th and 6th, 1933. President Ferguson was authorized to appoint a Chairman of the Committee on Local Arrangements, and Second Vice President after his visit to East St. Louis, December 12th.

The Secretary reported that the manuscripts for Nos. 1 and 2, vol. 25 of the Transactions of the Academy, had been sent to Springfield in July, and that estimates of the costs of publication of these numbers, as $165.00 and $1725.00 respectively, were obtained. Due to a shortage of state funds available for printing, the contracts for print-

ing these numbers have not yet been let. President Ferguson was requested to aid in obtaining the approval of the Department of Registration and Education for the placing of these contracts as soon as possible.

President Ferguson reported that he had been advised by Mr. Beekman, Business Manager of the Department of Registration and Education, that an appropriation of $4000 for the years 1933-35 for the printing of the Transactions of the Academy had been placed on the budget prepared by this department.

It was voted to authorize the Junior Section of the Academy to spend up to $50.00 more than the receipt of dues from Science Clubs affiliated with the Academy. The Secretary reported the receipt from Mr. L. A. Astell of an article published in "School Science and Mathematics" in October, 1932, on "The inspiration which the Junior Academy of Science has brought to the high school Science Clubs in the State of Illinois." This article gives a good history of the growth of the work of the Academy in the High School Science Club movement since its beginning in 1919.

It was voted to increase the funds authorized as expenditures by Miss Rose in the editing of the transactions of the Academy from $25.00 authorized at the First Council Meeting to $60.00, in accordance with her itemized estimate of expenses.

The Committee on Membership was authorized to expend not to exceed $120.00 in its annual campaign for new members, according to the plans for the campaign presented in a letter from Mr. D. L. Carroll, Chairman.

The Secretary read a letter from Mr. A. C. Walton, delegate to the A. A. A. S., stating that the financial support given to the State Academies by the American Association for the Advancement of Science might have to be withdrawn because of diminished income on the part of the Association. This matter was discussed, but no action was taken.

The Treasurer reported that of the present annual members of the Academy, about 1025, approximately 50 are in arrears since December, 1930, and 175 are in arrears since December, 1931. The former group, except those who may later pay up their back dues, will be dropped at the next annual meeting.

The President suggested that 100 or 200 extra copies of the Transactions of the Academy might be printed at Academy expense at the time those printed by the state are being prepared, for sale to libraries and others wishing to obtain complete sets of the publications of the Academy. This matter was referred to the Committee on Publications, with power to act.

The Secretary reported that numerous letters were received from Libraries and research organizations asking that the Transactions of

the Academy be sent to them. The Secretary was asked to communicate with Mr. Walton, delegate to the A. A. A. S., and learn from him the policy followed by other state Academies in regard to the distribution of their publications to libraries.

The Secretary was authorized to consult with Sectional Chairman relative to the appointment of advisers or assistants to cooperate with them in the preparation of the sectional programs for the 1933 annual meeting. Advisers or assistants to the sectional chairmen may be appointed by the Council.

A proposal made by members of the Committee in charge of the work of the Junior section, that sectional competitions between affiliated high school science clubs might be held in several districts of the state, preceding the competition at the time of the annual meeting of the Academy, was presented by the Secretary. Such a method would serve to give high school science club members in many parts of the state annual contact with the Academy. This proposal was discussed, but no action was taken. Plans for the organization of the meeting of the Junior section in 1933 were presented by Mr. Cockrum, and discussed by the Council.

Following a discussion of the functions of the Committee on Ecological Survey, the Secretary was asked to request that A. G. Vestal, Chairman of this Committee, prepare a brief statement of the work which it is hoped this committee may accomplish in the next few years, and distribute copies of this statement to members of the committee and to the Secretary.

The Secretary reported that the herbarium, donated several years ago by Mr. and Mrs. Moffatt to the Academy, had been donated by the Academy to the University of Illinois, and accepted for the University by President Chase.

The Secretary reported that several letters had been received from Illinois members of Congress in response to copies of resolutions passed by the Academy at its last annual meeting. One letter included a comprehensive statement by Mr. R. Y. Stuart, Forester, National Forest Reservation Commission, of the policies of this commission relative to the acquisition of new lands for National Forest Purchase Units, such as those proposed in Illinois. Copies of this letter were sent to those members of the Academy most interested in this matter.

The Secretary reported that nearly all of the papers submitted for publication in the Transactions for the current year had been submitted to censors, and that as a result of adverse criticism by the censors, six papers had not been accepted for publication, and in some other cases, alterations of the papers by the authors had been made at the suggestion of the censors.

The date of the next meeting of the council was tentatively set for February 25, 1933. The meeting adjourned at 5:00.

(Signed) Harold R. Wanless, *Secretary*

Third Meeting

The third meeting of the Council was called to order at 1:15 P. M., March 11, 1933, at the University Club, Urbana, with President Ferguson in the chair. The members present were G. D. Fuller, F. R. Jelliff, A. C. Noé, and H. R. Wanless. M. M. Leighton, former president, L. J. Thomas of the Committee on Publications, D. L. Carroll, Chairman of the Membership Committee, A. R. Kelly, E. F. Bogart, and W. H. Voskuil were present during parts of the meeting.

The minutes of the last meeting were read and approved.

Mr. Bogart reported that he had been authorized by the Economics Section at its last meeting to appoint the chairman for the 1933 meeting. He reported that the subject "Problems of the Coal Industry" had been chosen as an appropriate subject for a symposium for the 1933 meeting. Mr. Voskuil was appointed chairman of this section to prepare this program. Mr. Kelly reported preliminary plans for the program of the Anthropology Section and for a field trip to the Cahokia Mounds park.

The Secretary was authorized to extend invitations to the officers and members of the Academy of Science of St. Louis, the St. Louis Section, American Institute of Mining Engineers, the Madison-St. Clair Section, Illinois Society of Engineers, the East St. Louis Archaeology Club, the chairmen of scientific departments of Washington University, St. Louis University, Shurtleff College, McKendree College, and other colleges near East St. Louis, and to the principals of High Schools in the vicinity of East St. Louis to attend the sessions of the Academy.

President Ferguson reported that no requisitions are being approved by the Administrative Auditor, and that the chances of obtaining from the appropriation of $2000 for the year 1932-33 the funds necessary to print Nos. 1 and 2 of the Transactions were not now very promising. No new information was available about the probability of obtaining an appropriation for the publication of Transactions during the biennium 1933-35. In view of this emergency, the Committee on Publications was authorized to investigate the publication of No. 1 and the Preliminary Program (No. 3) at Academy expense, providing that this printing could be done at a cost of not over $200.00. The Committee was also authorized to investigate the possibility of obtaining a bid for printing the large number of the Transactions (No. 2) at a cost considerably below the $1725.00 estimated by the State Department of Printing.

Several proposals were made for the raising of funds to defray the cost of publishing the Transactions in the event that the funds appropriated by the State are not available. The Secretary was authorized to publish a proposed amendment to Article VIII of the constitution in the Preliminary program. The second paragraph of this article

would then read as follows: "All paid up members shall receive gratis the current publication of the Academy *except in case of emergency.*"

The President reported that Dr. Gunderson had resigned from the Chairmanship of the Medicine and Public Health Section. It was decided not to organize a sectional meeting for this group at the 1933 annual meeting, but to plan the general program mainly in this field. Preliminary plans for the general program were discussed.

Mr. Carroll reported that an active canvassing of persons eligible for membership had been made, and that letters had been sent to 200 members of the Academy, urging them to take out life membership. The canvass had not thus far been highly successful, but the Treasurer reported that 39 new applicants for annual membership and two applicants for life membership had been admitted.

The Committee on Publications was authorized to print a statement in the Preliminary Program that it might be necessary to limit each author of papers to an allotment of 4 pages of printed material, or even to publish only abstracts during the next year, and request the authors to condense their material greatly with this object in view. The Committee was also authorized to consider the omission of the membership list from No. 1 of Volume 25.

The Secretary reported that because of a small number of papers in the Physics Section, it would be desirable to have this section meet in joint session with the Chemistry Section for a part of the meeting. Because of the large number of titles (24) offered in Zoology it seemed desirable to plan to separate this section into two smaller groups for a part of the meeting, the groups to consist of the zoological and entomological papers. The Secretary reported that the other sectional programs, except that in Psychology and Education, were quite satisfactory.

The Secretary was instructed to go to East St. Louis at an early date to effect the local arrangements with Mr. Eversull, local Chairman, who was unable to attend this meeting. In the absence of Mr. Cockrum, no report was available of the plans for the meeting of the Junior Section.

The Secretary reported that Dr. F. M. Fryxell of Augustana College, Rock Island, was preparing arrangements for an invitation to the Academy to hold its 1934 annual meeting in Rock Island and Moline. The Council approved these preliminary arrangements and suggested that the Secretary correspond with the Secretary of the Iowa Academy of Science, to take up the matter of a possible joint meeting of the two Academies in 1934.

The Secretary reported for Mr. Vestal, Chairman of the Committee on Ecological Survey, that this committee was prepared to bring up to date the bibliography on Illinois Ecology which was first prepared by this committee in 1928. The Council approved this plan, and recom-

mended that the bibliography be published when it was completed, if funds for this were available. A project for the preparation of a guide book to points of unusual ecological interest in Illinois was also approved.

The Council voted to continue Dr. A. C. Walton as delegate to the Academy conference, A. A. A. S. for the Chicago and Boston meetings in 1933. The President appointed Messrs. Cole, Noé, and Fuller as a committee to consider plans for participation by the Academy in the Chicago meeting of the A. A. A. S., with power to act.

The Secretary read a report prepared by Mr. Walton on the publication practices of State Academies affiliated with the A. A. A. S., and recommendations toward changes in these practices during periods of decreased income. The Secretary was asked to have copies of this report sent to members of the Council and the Committee on Publications.

The Council voted to allow the Committee on Local Arrangements to spend not more than $25.00 in effecting arrangements for the meeting.

The President appointed as a publicity committee for the East St. Louis meeting, Dr. M. M. Leighton, Mr. D. L. Carroll, and the Secretary.

The Secretary reported that payment by the A. A. A. S. of $.50 for each paid up national member was expected by March 31st, and that the number of such members was somewhat in excess of 360.

The Council voted to discontinue temporarily any sections of the Academy for which there seemed no urgent need. The Secretary was authorized to select one or more members of each section to act as advisor to the Chairman in the preparation of programs, where such assistance appears to be needed.

The meeting adjourned at 5:15 P. M.

(Signed) Harold R. Wanless, *Secretary*

MEMOIR

SAMUEL WILSON PARR

SAMUEL WILSON PARR

1857–1931

On May 16, 1931, one of the notable group which organized the Illinois Academy of Science in Springfield in 1907 and gathered at the first regular meeting in Decatur in 1908, passed from our midst.

Professor Parr was born at Granville, Illinois, January 21, 1857. He graduated from the University of Illinois in 1884 and received the degree of Master of Science at Cornell University in 1885. After teaching for a few years at Illinois College, he returned to the University of Illinois as Professor of Applied Chemistry and, with the exception of a year's leave of absence passed in Berlin and Zurich, he spent a long and active life in work at Urbana.

His first important scientific paper was published when he was forty years of age and he demonstrated that a man who has little opportunity for productive research in early life may do work of outstanding importance later on.

At the first regular meeting of the Academy, at Decatur in 1908, he presented a paper on the "Weathering and Deterioration of Coal", which illustrates his major interest in fuels throughout years of research.

His peroxide calorimeter has been very useful, practically, for determining the calorific value of coals and the story of the development of the alloy "Illium", as resistant as platinum to the action of dilute acids, for use in making a bomb calorimeter, reads like a romance.

Perhaps his most notable achievement was his development, with the assistance of T. E. Layng, of a process for coking coal which depends on the exothermic reaction that sets in when a dried bituminous coal is heated to redness. By this method the twelve or fourteen hours required in a by-products coking oven may be reduced to four or five.

Professor Parr's kindly and helpful personality led to very close attachments between him and his students and won for him a wide circle of friends. Employers who had occasion to consult him about men suitable for their work came to rely almost implicitly upon his judgment.

He was President of the American Chemical Society in 1928 and received many other distinguished honors.

Although he was twenty-seven when he graduated from college, he was active in athletics, especially in baseball, and he was the first President of the Athletic Association of the University. As an orator he won the University contest and represented the University at the State oratorical contest. This interest in other things as well as in his scientific work was characteristic of him throughout his life. He was in the Church choir and was long chairman of the music committee. He was one of the leaders among the Directors of the Y. M. C. A. at the University.

W. A. Noyes

CONSTITUTION AND BY-LAWS
OF THE
ILLINOIS STATE ACADEMY OF SCIENCE

CONSTITUTION

Article I. Name

This Society shall be known as The Illinois State Academy of Science.

Article II. Objects

The objects of the Academy shall be the promotion of scientific research, the diffusion of scientific knowledge and scientific spirit, and the unification of the science interests of the State.

Article III. Members

The membership of the Academy shall consist of two classes as follows: *National Members* and *Local Members.*

National Members shall be those who are members also of the American Association for the Advancement of Science.

Local Members shall be those who are members of the local Academy only. Each member, except life members of the Academy, shall pay an admission fee of one dollar and an annual assessment of one dollar.

Both national members and local members may be either *Life Members, Active Members, or Non-resident Members.*

Life Members shall be national or local members who have paid fees to the Academy to the amount of twenty dollars at one time or complete payments before the annual meeting of 1928. The dues from such a source are to be placed as a permanent fund and only the income is to be used.

Active Members shall be national or local members who reside in the State of Illinois.

Non-resident Members shall be active members or life members who have removed from the State of Illinois. Their duties and privileges shall be the same as active members except that they may not hold office.

Charter Members are those who attended the organization meeting in 1908, signed the constitution, and paid dues for that year.

For election to any class of membership, the candidate's name must be proposed by two members, be approved by a majority of the committee on membership, and be acted upon favorably by a majority vote of the Council.

Article IV. Officers

The officers of the Academy shall consist of a President, a First Vice-President, a Second Vice-President, a Secretary, a Treasurer, a Librarian, and an Editor. These officers, with the exception of the Second Vice-President, the Librarian, and the Editor, shall be chosen by ballot at the annual meeting and shall hold office for one year or until their successors qualify.

The Second Vice-President, who may be a resident of the town in which the next annual meeting is to be held, may be appointed by the Council each year when the next meeting place shall have been decided upon, in order that he may serve as ex-officio chairman of the Committee on Local Arrangements.

The Chief of the State Museum Division of the Department of Registration and Education of the State of Illinois shall be the Librarian of the Academy.

The Editor shall be selected by the Council upon the recommendation of the Committee on Publication.

The above officers shall perform the duties usually pertaining to their respective offices.

It shall be one of the duties of the President to prepare an address which shall be delivered before the Academy at the annual meeting at which his term of office expires.

The Librarian shall have charge of all the books, collections, and material property belonging to the Academy.

The Editor, under the direction of the Committee on Publication, shall have entire charge of the editing and printing of the annual volume of the Transactions and also of such other papers as the Committee on Publication shall deem advisable.

Article V. Council

The Council shall consist of the President, First Vice-President, Second Vice-President, Secretary, Treasurer, Librarian, the retiring president and his immediate predecessor, and the Secretary of the preceding year. To the Council shall be entrusted the management of the affairs of the Academy during the intervals between regular meetings.

At the Annual Meetings the presiding officer of each of the affiliated scientific societies of the State shall meet with the Academy Council for the discussion of policies.

Article VI. Standing Committees

The Standing Committees of the Academy shall be a Committee on Publication, a Committee on Membership, and a Committee on Affiliation and such other committees as the Academy shall from time to time deem desirable.

The Committee on Publication shall consist of the President, the Secretary and a third member chosen annually by the Academy. It shall pass upon the papers published by the Academy, subject to review by the Council.

The committees on Membership and Affiliation shall each consist of five members chosen annually by the Academy.

Article VII. Meetings

The regular meetings of the Academy shall be held at such time and place as the Council may designate. Special meetings may be called by the Council, and shall be called upon written request of twenty members.

Article VIII. Publications

The regular publications of the Academy shall include the Transactions of the Academy and such papers as are deemed suitable by the Committee on Publication.

All paid up members shall receive gratis the current publication of the Academy.

Article IX. Affiliation

The Academy may enter into such relations of affiliation with other organizations of appropriate character as may be recommended by the Council, and may be ordered by a three-fourths vote of the members present at any regular meeting.

Article X. Amendments

This constitution may be amended by a three-fourths vote of the membership present at an annual meeting, provided that notice of the desired change has been sent by the Secretary to all members at least twenty days before such meeting.

BY-LAWS

I. The following shall be the regular order of business:

1. Call to order.
2. Reports of officers.
3. Reports of standing committees.
4. Election of members.
5. Reports of special committees.
6. Appointment of special committees.
7. Unfinished business.
8. New business.
9. Election of officers.
10. Program.
11. Adjournment.

II. No meeting of the Academy shall be held without thirty days previous notice by the Secretary to all members.

III. Fifteen members shall constitute a quorum of the Academy. A majority of the Council shall constitute a quorum of the Council.

IV. No bill may be incurred against the Academy by officers or committees in excess of five dollars, except as provided for in By-law IX, unless approved by the Council. No bill against the Academy shall be paid without an order signed by the President and the Secretary.

V. Members who shall allow their dues to remain unpaid for three years, having been annually notified of their arrearage by the Treasurer, shall have their names stricken from the roll.

VI. The Librarian shall have charge of the distribution, sale, and exchange of the published Transactions of the Academy, under such restrictions as may be imposed by the Council.

VII. The presiding officer shall at each annual meeting appoint a committee of three who shall examine and report in writing upon the account of the Treasurer.

VIII. No paper shall be entitled to a place on the program unless the manuscript or an abstract of the same shall have been previously delivered to the Secretary. No paper shall be presented at any meeting, by any person other than the author, except on vote of the members present at such meeting. Manuscripts of papers must be handed to the Secretary at the time of the Annual meeting. All papers are limited to twenty pages, additional pages are to be paid for by the author. Except by invitation of the Council, no paper may be accepted for the program unless the author is a member of the Academy or an applicant for membership. No paper shall be accepted for publication which has already been published elsewhere.

IX. The Secretary and the Treasurer shall have their expenses paid from the Treasury of the Academy while attending council meetings and annual meetings. Other members of the Council may have their expenses paid while attending meetings of the Council, other than those in connection with annual meetings.

X. These by-laws may be suspended by a three-fourths vote of the membership present at any regular meeting.

XI. The Treasurer shall maintain a permanent fund for the Academy, only the interest on which may be used. This permanent fund shall consist of (1) life membership dues, (2) donations, and (3) funds as the Council may see fit from time to time to add from accumulations in the treasury.

CONSTITUTION AND BY-LAWS

JUNIOR SECTION

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

CONSTITUTION

Article I. Name

This organization shall be known as the Junior Section of the Illinois State Academy of Science.

Article II. Objects

The object of this organization shall be to create and foster the best interest of science together with the spirit of American democracy through scientific, moral, and social activities in the various high schools and communities of the state.

Article III. Membership

The membership shall consist of the active members of the various scientific clubs affiliated with the Illinois State Academy of Science, under the rules and regulations prescribed by the latter Society.

Article IV. Delegates

The number of delegates from each club shall be the same regardless of the size of the club.

This number of delegates will be determined annually by the Governing Committee as prescribed in Article VI below.

Only the official delegates of the various clubs shall vote on the matters representing the official business of the organization.

These provisions shall not be construed as barring additional guests from the several clubs as far as accommodations can be provided.

Article V. Officers

The officers of the Junior Section of the Illinois State Academy of Science shall consist of a President, a Vice-President, a Secretary, and a Treasurer.

These officers shall be elected by the delegates from the several clubs represented at the rgular annual meetings of the organization.

The above officers shall perform the duties usually pertaining to their respective offices.

Article VI. Governing Committee

The Governing Committee shall consist of the chairman of the Section of the Illinois State Academy of Science designated as "High School Science Clubs," together with such other members as may be elected by the Junior Section.

This committee shall in turn be governed through the Council of the Illinois State Academy of Science, through constitution and by-laws of the latter society in-so-far as they may involve the activities of the Junior Section of the Illinois State Academy of Science.

Article VII. Limitation of Expenses

No bills in excess of $5.00 shall be incurred by the Junior Section without the authorization of the Council of the State Academy.

Article VIII. Bills

No bill against the Junior Section of the Illinois State Academy of Science shall be paid without an order endorsed by the President, Secretary, and Treasurer of the Illinois State Academy of Science and the chairman of the Governing Committee of the Junior Section.

Article IX. Meetings

The regular meeting of the Junior Section of the Illinois State Academy of Science shall be held at such time and at such place as the Council of the Illinois State Academy of Science may designate. Special meetings may be called by the chairman of the Governing Committee, by written notice to the several members of the said committee.

Article X. Affiliation

Affiliation of the various clubs with the Illinois State Academy of Science shall obtain in the manner prescribed by that Society.

Article XI. Dues and Special Assessments

Dues and special assessments in addition to the fees for affiliation above, may be made by the Governing Committee, providing such levies are in keeping with the provisions of Articles VII and VIII above.

Article XII. Amendments

This constitution may be amended by a three-fourths vote of the official delegates present at an annual meeting, and subject to ratification of the Council, provided that notice of the desired change has been sent to the chairman of the Governing Committee and to the Secretaries of the State Academy and the Junior Section of the Illinois State Academy of Science at least twenty days before such meeting.

BY-LAWS

I. The following shall be the regular order of business:

1. Call to order.
2. Reports of officers.
3. Reports of standing committees.
4. Election of members; i. e., recognition of new clubs affiliated with the Academy, etc.
5. Reports of special committees.
6. Appointment of special committees.
7. Unfinished business.
8. New business; roll call of clubs for reports of outstanding activity.
9. Election of officers.
10. Program.
11. Adjournment.

II. The Chairman of the High School Section shall at each annual meeting appoint a committee of three who shall examine and report in writing upon the account of the Treasurer.

III. These by-laws may be suspended by a three-fourths vote of the official delegates present.

SCIENTIFIC SOCIETIES AFFILIATED WITH THE ACADEMY

Botany Club of Joliet, care of H. V. Givens, Midland Ave., Joliet, Ill.
Chicago Academy of Science, Lincoln Park, Chicago, Ill. (1925.)
Chicago Nature Study Club, 3842 Byron St., Chicago, Ill., care of Dr. H. S. Pepoon. (1927.)
Illinois Association of Biology Teachers, Mary R. Earnest, Sec'y, Decatur High School, Decatur, Ill. (1928.)
Illinois Association of Chemistry Teachers, Rosalie M. Parr, Sec'y, 321 Chemistry Bldg., Urbana, Ill. (1928.)
Illinois Nature Study Society of Elgin, Carl F. Gronemann, President, 310 N. Liberty St., Elgin, Ill. (1924.)
Knox County Academy of Science, Galesburg, Ill., C. L. Furrow, President. (1923.)
Normal Science Club, Illinois State Normal University, care of Bessie I. Hibarger, Treas., 200 W. Mulberry St., Normal, Ill. (1923.)
Peoria Academy of Science, Arthur L. Epstein, Pres., Peoria High School, Peoria, Ill. (1931.)
Rockford Nature Study Society, care of Miss Frances S. Dobson, 312 N. Avon St., Rockford, Ill. (1923.)
Sigma Xi, University of Chicago Chapter, University of Chicago, Chicago, Ill. (1925.)
Sigma Xi, University of Illinois Chapter, Urbana, Ill. (1925.)
Sigma Zeta Society, care of Prof. R. K. Carleton, Shurtleff College, Alton, Ill. (1929.)
Southern Illinois Science Club, Southern Illinois State Teachers' College, Carbondale, Ill. (1926.)
Theta Chi Delta, Alpha Eta Chapter, Carthage College, Carthage, Ill. (Chemistry.) (1929.)

AFFILIATED HIGH SCHOOL SCIENCE CLUBS

Amateur Burroughs Club, Bloomington High School, Bloomington, Ill. (1931.)
Arlington Heights Science Club, Arlington Heights, Ill. (1930.)
Assumption Science Club, Assumption Township High School, Assumption, Ill. (1931.)
Atwood Science Club, Atwood, Ill. (1930.)
Biology Club, Carter H. Harrison Technical High School, Chicago, Ill. (1930.)
Biology Club, University of Chicago High School, Chicago, Ill. (1932.)
Cairo Science Club, High School, Cairo, Ill. (1932.)
Casey Science Club, Casey, Ill. (1931.)
Champaign Science Club, Champaign, Ill. (1931.)
Chicago Heights Science Club, Chicago Heights, Ill. (1932.)
Collinsville Science Club, Collinsville, Ill. (1932.)
Danville Science Club, Danville High School, Danville, Ill. (1923.)
Dixon High School Biology Club, Dixon, Ill.
Dupo Community High School Nature Club, Dupo, Ill. (1931.)
East St. Louis High School Chemistry Club, East St. Louis, Ill. (1930.)
Edison, Michaelson, Steinmetz Science Club, Graham Junior High School, Chicago, Ill. (1932.)
Edisonian Science Club, Henry, Ill. (1926.)
Edisonian Science Club, Robinson, Ill. (1930.)
Edisonian Science Club, Roosevelt Jr. High School, Rockford, Ill. (1930.)
Edisonian Science Club, West Chicago Community High School, West Chicago, Ill. (1928.)
Englewood Biology Club, Englewood High School, Chicago, Ill. (1925.)
Fairfield Science Club, Fairfield, Ill. (1932.)
Faraday Science Club, Wendell Phillips Sr. High School, Chicago, Ill. (1930.)
Franklin Science Club, Marion, Ill. (1931.)
Galesburg High School Boys' Science Club, Galesburg, Ill. (1922.)
Geneseo Club, Geneseo Township High School, Geneseo, Ill. (1931.)

Gibson City High School Science Club, Gibson City, Ill. (1931.)
Gillespie High School Science Club, Gillespie, Ill. (1931.)
Glenbard Science Club, Glenbard High School, Glen Ellyn, Ill. (1930.)
Granite City Community High School, Chemistry Club, Granite City, Ill. (1930.)
Granite City Community High School, Vocational Science Club, Granite City, Ill. (1930.)
Hall Township High School Science Club, Spring Valley, Ill. (1931.)
Illinium Science Club, Paris High School, Paris, Ill. (1930.)
Lincoln Chemistry Club, Lincoln Junior High School, Rockford, Ill. (1931.)
Louis Agassiz Biology Club, Sesser, Ill. (1932.)
Maine Chemistry Club, Des Plaines, Ill. (1930.)
Mendel Science Club, Visitation High School, Chicago, Ill. (1932.)
Metamora Township High School Chemistry Club, Metamora, Ill. (1931.)
Modern Alchemists Club, High School, Bloomington, Ill. (1930.)
Morgan Park High School Science Club, Chicago, Ill. (1930.)
Morton High School Biology Club, Cicero, Ill. (1932.)
Morton Weather Club, Morton High School, Cicero, Ill. (1932.)
Mote Scientifique, Hononegah Community High School, Rockton, Ill. (1931.)
Mt. Pulaski Science Club, Pulaski Township High School, Mt. Pulaski, Ill. (1929.)
Newman Township High School Science Club, "The Chem 12", Newman, Ill. (1931.)
New Trier Geology Club, New Trier High School, Winnetka, Ill. (1931.)
New Trier Ornithology Club, New Trier High School, Winnetka, Ill. (1931)
Nokomis High School Science Club, Nokomis, Ill. (1930.)
Parker Biology Club, Parker Senior High School, Chicago, Ill. (1932.)
Parker Science Club, Parker Senior High School, Chicago, Ill. (1930.)
Pekin High School Science Club, Pekin, Ill. (1931.)
Peoria High School Science and Mathematics Club, Peoria, Ill. (1931.)
Rockford Senior High School Biology Club, Rockford, Ill. (1930.)
Rockford High School Chemistry Club, Rockford, Ill. (1930.)
Rockford Senior High School Psychology Club, Rockford, Ill. (1930.)
Sienna High School Chemistry Club, 5600 Washington Blvd., Chicago, Ill. (1931.)
Sienna High School Science Club, 5600 Washington Blvd., Chicago, Ill. (1931.)
Springfield High School Science Club, Springfield, Ill. (1931.)
University High Science Club, University of Illinois High School, Urbana, Ill. (1930.)
Villa Grove High School Science Club, Villa Grove, Ill. (1930.)
Visitation High School Chemistry Club, 900 W. Garfield Blvd., Chicago, Ill. (1932.)
Volta Club, Visitation High School, 900 W. Garfield Blvd., Chicago, Ill. (1931.)
Warren Township High School Biology Club, Gurnee, Ill. (1930.)
Watseka High School Science Club, Watseka, Ill. (1931.)
Western Illinois State Teachers College Science Club, Macomb, Ill. (1931.)

LIBRARIES RECEIVING THE TRANSACTIONS, 1932

Academy of Natural Science, Logan Square, Philadelphia, Pa.
Antioch College, Yellow Springs, Ohio.
Armour Institute of Technology, Chicago, Ill.
Augustana College, Rock Island, Ill.
Bradley Polytechnic Institute, Peoria, Ill.
British Museum of Natural History, Cromwell Road, London, England.
Brooklyn Botanic Gardens, Bronx Park, Brooklyn, N. Y.
Butler University, Indianapolis, Ind.
Carnegie Library, Pittsburgh, Pa.
Carnegie Museum, Schenley Park, Pittsburgh, Pa.
Carthage College, Carthage, Ill
Cleveland Museum of Natural History, 2717 Euclid Avenue, Cleveland, Ohio
Cleveland Public Library, Cleveland, Ohio.
Colgate University, Hamilton, N. Y.
Colorado Scientific Society, Denver Public Library, Denver, Colo.
Dartmouth College, Hanover, New Hampshire.

Davenport Public Museum, Davenport, Ia.
De Paul University, Chicago, Ill.
Elmhurst College, Elmhurst, Ill.
Enoch Pratt Free Library, Baltimore, Md.
Eureka College, Eureka, Ill.
Greenville College, Greenville, Ill.
Illinois College, Jacksonville, Ill.
Illinois State Geological Survey, Urbana, Ill.
Illinois State Library, Springfield, Ill. (3 copies.)
Illinois State Natural History Survey, Urbana, Ill.
Illinois Wesleyan University, Bloomington, Ill.
Illinois Womans' College (MacMurray College), Jacksonville, Ill.
James Millikin University, Decatur, Ill.
Kenyon College, Gambier, Ohio.
Knox College, Galesburg, Ill.
Lake Forest College, Lake Forest, Ill.
Lewis Institute, Chicago, Ill.
Lincoln College, Lincoln, Ill.
Los Angeles Museum, Los Angeles, Calif.
Louisiana State University (Hill Memorial Library), Baton Rouge, La.
Loyola University, Chicago, Ill.
Massachusetts Institute of Technology, Cambridge, Massachusetts.
McKendree College, Lebanon, Ill.
Missouri School of Mines, Rolla, Mo.
Monmouth College, Monmouth, Ill.
Mt. Morris College, Mt. Morris, Ill.
Museum of Northern Arizona, Flagstaff, Ariz.
Natural History Museum, San Diego, Calif.
North Central College, Naperville, Ill.
Northwestern University, Evanston, Ill.
Ohio State Archeological and Historical Society, Columbus, Ohio.
Ohio State University Library, Columbus, Ohio.
Rockford College, Rockford, Ill.
Rosenwald Museum of Science and Industry, Chicago, Ill.
Smithsonian Institution, Washington, D. C.
St. Norbert's College, West De Pere, Wis.
St. Procopius College, Lisle, Ill.
St. Viator College, Bourbonnais, Ill.
Shurtleff College, Alton, Ill.
State Normal University, Normal, Ill.
State Teachers College, Carbondale, Ill.
State Teachers College, Charleston, Ill.
State Teachers College, De Kalb, Ill.
State Teachers College, Macomb, Ill.
Texas Christian University, Fort Worth, Tex.
United States Geological Survey, Washington, D. C.
University of Arkansas, Fayetteville, Ark.
University of California, Berkeley, Calif.
University of Chicago, Chicago, Ill.
University of Illinois, Urbana, Ill.
University of Michigan (General Library), Ann Arbor, Mich.
University of Nebraska, Lincoln, Neb.
University of North Carolina (Department of Geology), Chapel Hill, N. C.
University of Oklahoma, Norman, Okla.
University of Texas, Austin, Tex.
University of West Virginia, Morgantown, W. Va.
Vanderbilt University (Department of Geology), Nashville, Tenn.
Western Reserve University, Cleveland, Ohio.
Weston College, Weston, Mass.
Wheaton College, Wheaton, Ill.
Yale University (Department of Geology), New Haven, Conn.
Yale University (Peabody Museum of Natural History), New Haven, Conn.

EXCHANGE LIST OF OTHER STATE ACADEMIES

Affiliated with the American Association for the Advancement of Science

ALABAMA ACADEMY OF SCIENCE
Secretary: J. L. Brakefield, Howard College, Birmingham, Ala.

COLORADO-WYOMING ACADEMY OF SCIENCE
Secretary: J. Harlan Johnson, Colorado School of Mines, Golden, Colo.

GEORGIA ACADEMY OF SCIENCE
Secretary: George H. Boyd, University of Georia, Athens, Ga.

INDIANA ACADEMY OF SCIENCE
Secretary: Ray C. Friesner, Butler University, Indianapolis, Ind.

IOWA ACADEMY OF SCIENCE
Secretary: J. C. Gilman, Iowa State College, Ames, Ia.

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Secretary: George E. Johnson, Kansas State Agriculture College, Manhattan, Kans.

KENTUCKY ACADEMY OF SCIENCE
Secretary: A. M. Peter, Agricultural Experiment Station, Lexington, Ky.

MARYLAND ACADEMY OF SCIENCES
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MICHIGAN ACADEMY OF SCIENCE
Secretary: Leigh J. Young, University of Michigan, Ann Arbor, Mich.

NEBRASKA ACADEMY OF SCIENCE
Secretary: M. P. Brunig, College of Agriculture, Lincoln, Nebr.

NEW HAMPSHIRE ACADEMY OF SCIENCE
Secretary: George W. White, University of New Hampshire, Durham, N. H.

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Secretary: H. E. Buchanan, Tulane University, New Orleans, La.

NORTH CAROLINA ACADEMY OF SCIENCE
Secretary: H. R. Totten, University of North Carolina, Chapel Hill, N. Car.

NORTH DAKOTA ACADEMY OF SCIENCE
Secretary: G. A. Abbott, University of North Dakota, Grand Forks, N. Dak.

OHIO ACADEMY OF SCIENCE
Secretary: William H. Alexander, 8 E. Broad St., Columbus, Ohio.

OKLAHOMA ACADEMY OF SCIENCE
Secretary: Herbert Patterson, Oklahoma A. and M. College, Stillwater, Okla.

PENNSYLVANIA ACADEMY OF SCIENCE
Secretary: T. L. Guyton, Pennsylvania Dept. of Agriculture, Harrisburg, Pa.

ACADEMY OF SCIENCE OF ST. LOUIS
Secretary: Alexander S. Langsdorf, Washington University, St. Louis, Mo.

SOUTH CAROLINA ACADEMY OF SCIENCE
Secretary: G. C. Mance, Winthrop College, Rock Hill, S. Car.

TENNESSEE ACADEMY OF SCIENCE
Secretary: John T. McGill, Vanderbilt University, Nashville, Tenn.

TEXAS ACADEMY OF SCIENCE
Secretary: H. B. Parks, Route 1, Box 368, San Antonio, Tex.

VIRGINIA ACADEMY OF SCIENCE
Secretary: E. C. L. Miller, 12th and Clay Sts., Richmond, Va.

WEST VIRGINIA ACADEMY OF SCIENCE
Secretary: H. A. Davis, West Virginia University, Morgantown, W. Va.

WISCONSIN ACADEMY OF SCIENCES, ARTS, AND LETTERS
Secretary: Lowell E. Noland, University of Wisconsin, Madison, Wis.

WYOMING, see Colorado-Wyoming.

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TRANSACTIONS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

VOLUME 25 MARCH, 1933 NUMBER 3

Minutes of Council Meetings
Minutes of Twenty-sixth Annual Meeting
Reports of Officers and Committees

EDITED BY DOROTHY E. ROSE

Published by the Illinois State Academy of Science
DEPARTMENT OF REGISTRATION AND EDUCATION
STATE MUSEUM DIVISION, CENTENNIAL BUILDING
SPRINGFIELD, ILLINOIS

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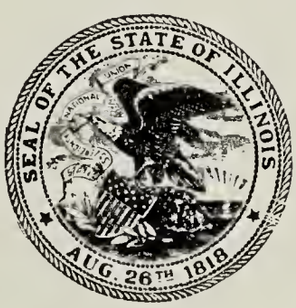

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TRANSACTIONS OF THE ILLINOIS STATE ACADEMY OF SCIENCE

Volume 25 March, 1933 Number 3

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JUL 16 1935

Minutes of Meetings of the 1932-1933 Council

Fourth Meeting*

The fourth meeting of the Council was called to order at 7:45 p. m., May 4, 1933, at the Broadview Hotel, East St. Louis, with President Ferguson in the chair. The members present were F. L. Eversull, G. D. Fuller, F. R. Jelliff, and H. R. Wanless. The minutes of the third meeting of the Council were read and approved.

The Secretary reported the results of estimates obtained for the publication of the two numbers of the *Transactions* for the preceding year. The Council approved the publication of the smaller number without the membership list as Volume 25, No. 2 at the lowest bid which might be obtained. Various methods for financing the publication of the larger number were discussed, but no action was taken.

Mr. Eversull reported that all the details for the forthcoming meeting had been arranged.

The Secretary reported that Dr. Fryxell had asked that the invitation for the Academy to meet in Rock Island be postponed from 1934 to 1935.

The Treasurer reported that forty-nine new applicants for membership had paid their dues. The Council voted the election of these members.

The Secretary reported for the Committee on pre-meeting publicity that approximately 200 programs and personal invitations were sent out to residents of the region contiguous to East St. Louis.

The meeting was adjourned at 9:30 p. m.

(Signed) Harold R. Wanless, *Secretary*

Reports of Officers and Committees For 1932-1933

Report of the Secretary

Minutes of the Twenty-Sixth Annual Meeting, East St. Louis

First Business Session

The first business session of the Twenty-sixth Annual Meeting of the Academy was called to order at 9:25 a. m., May 5, 1933, at the Broadview Hotel, East St. Louis, by President Ferguson, with forty members present.

The President announced the appointment of the following special committees to prepare reports for the final business session of this meeting:

Nominations Committee: Clarence Bonnell of Harrisburg, *Chairman,* F. R. Jelliff of Galesburg, and M. M. Leighton of Urbana.

Resolutions Committee: H. J. Van Cleave of Urbana, *Chairman,* G. E. Ekblaw of Urbana, and A. C. Walton of Galesburg.

Auditing Committee: Scott V. Eaton of Chicago, *Chairman,* A. C. Noé of Chicago, and J. M. Beal of Chicago.

The business session was then adjourned until 11:00 a. m.

* Minutes of the first, second, and third meetings of the 1932-1933 Council are recorded in Volume 25, No. 2, pp. 31-37, December, 1932.

General Session

The general session of the Twenty-sixth Annual Meeting was opened about 9:30 a. m., in the same room, before an audience of about one hundred and fifty.

President Ferguson delivered his address as retiring president of the Academy on *The Future of the Illinois Academy of Seience.* Dr. M. B. Visscher of the University of Illinois College of Medicine then spoke on *Medieal Science, its Past, Present, and Future.* The final address of the general session was delivered by Dr. Frank J. Jirka, director of the State Department of Public Health, on the subject *Advances in the Science of Public Health.**

Second Business Session

The second session of the business meeting of the Academy was called to order by President Ferguson at 11:30 a. m., in the same hall, with sixty members present.

Minutes of the first business session were read and approved.

The report of the Treasurer was read, approved, and submitted to the Auditing Committee.

The reports of the Editor and Librarian were read and accepted.

No report was presented for the Committee on Affiliation, as there have been no applicants for affiliation.

The report of the Committee on Ecological Survey was read and accepted.

No report was presented by the Committee on Conservation, due to the illness of its chairman, Dr. H. C. Cowles. Dr. T. H. Frison, a member of this committee, however, made some remarks on the present state of the National Forest Purchase Movement in Illinois.

The report of the Committee on Publications was read and accepted. It was voted that the problem of publication policies be referred to the incoming Council.

The report of the Committee on Membership was read and accepted. Dr. Leighton recommended that copies of outstanding addresses like those given by Drs. Visscher and Jirka might be printed and copies given a wide circulation by the Academy.

The reports of the Committee on State Hall of Fame, the Committee on High School Science and Clubs, the delegate to the Academy Conference of the A.A.A.S., the delegate to the Conservation Council of Chicago were read and accepted.

The following amendment to Article VIII of the Constitution was adopted:

A change (indicated by *italics*) in the last paragraph of Article VIII relative to the distribution of publications, to read as follows:

> "All paid up members shall receive gratis the current publication of the Academy, *except in case of an emergency.*"

As no new business was presented, the meeting was adjourned at 12:15 p. m.

Third Business Session

The final session of the annual business meeting of the Academy was called to order at 5:10 p. m., at the East St. Louis Senior High School by President Ferguson, with thirty members present.

The minutes of the second session were read and approved.

The report of the Committee on Resolutions was given by Chairman Van Cleave. The report was accepted by vote of the members present.

The Committee on Nominations brought the following recommendations:

For President, B. Smith Hopkins, University of Illinois, Urbana; for First Vice-President, Charles H. Behre, Northwestern University, Evanston; for Secretary, Harold R. Wanless, University of Illinois, Urbana; for Treasurer, George D. Fuller, University of Chicago, Chicago.

For the third member of the Committee on Publications, Lyell J. Thomas.

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* Summaries of these addresses are to be published in Volume 26.

For the Committee on Membership: Don L. Carroll, of Urbana, Chairman; Vida Latham, of Chicago; B. K. Richardson, of Springfield; A. C. Noé, of Chicago; and a member to be chosen by the Council from the city in which the 1934 meeting is held.

For the Committee on Affiliation; John C. Hessler, of Galesburg, Chairman; H. H. Radcliff, of Decatur; Rosalie M. Parr, of Urbana; Charles D. Sneller, of Peoria; and Mary M. Steagall, of Carbondale.

It was moved and seconded that the nominations be closed, and the Secretary be instructed to cast a ballot for the nominees. The motion was carried with no dissenting votes and the nominees were declared elected.

The Report of the Auditing Committee was presented by A. C. Noé, and was accepted by vote of those present.

An invitation to the Academy to hold the 1934 meeting at Decatur was extended by J. H. Ransom, and an invitation to Springfield was extended by President Ferguson. It was voted to refer the choice of a meeting place for the 27th Annual Meeting to the incoming Council, with power to act.

As no further business was presented, the meeting was adjourned at 5:30 p. m.

(Signed) Harold R. Wanless, *Secretary*

Junior Section Meeting

The annual meeting of the Junior Section of Affiliated Science Clubs was well attended and representatives of clubs from all parts of the state were registered.

The keen interest and enthusiasm for the many branches of high school science was manifested in the character of the exhibits. A large display room at the Broadview Hotel was used for the display of projects submitted by the various clubs. The new division of Geology was well represented and contained some excellent exhibits. This addition to our section promises to be one of exceptional worth. The Chemistry exhibits were outstanding and the commercial exhibits showed clearly the progress being made to connect the subject of Chemistry with the Chemistry of industry. The Biology group was the most elaborate in the history of the Junior Section of the Academy. Many of the entries showed the results of long and patient work under skillful guidance. Classifications were accurate and detailed, drawings were neat and the entire display was highly satisfactory. The Physics exhibits were exceptionally good due in some part to the fact that this section had been subdivided to allow more entries.

The News Letter contest which was carried on throughout the year has more than proved itself to be a worthy student project. This organ for disseminating information concerning the activities of the clubs has been of such value that plans are being made to secure the approval of the Council for its continuation on a larger scale. The annual business meeting was held in the Auditorium of the East St. Louis High School.

The Junior Section was privileged to have an address from one of its closest friends and founders, Louis A. Astell, of Kankakee, who spoke on "Challenges." This address brought out the many opportunities and possibilities for young people in science today. Dr. C. T. Knipp, of the University of Illinois, gave an inspirational physics lecture and demonstration. The elaborate apparatus and the technique with which Dr. Knipp manipulated this equipment was an inspiration and a goal of achievement to the boys and girls. This program was attended by approximately a hundred and thirty affiliated club members.

The annual Banquet was held in the Rathskeller where an excellent program had been arranged to accompany the dinner. The delegates asked that a vote of thanks and appreciation be extended to our hosts, Frank L. Eversull, of East St. Louis Senior High School, and to the Illinois State Academy of Science for making it possible for us to meet under its auspices.

The Saturday morning program consisted of conducted trips under the supervision of the Senior Academy. The Anthropological and Botanical trips were the most popular with our section. The members of the Junior Section were especially pleased to be included in the regularly planned trips of the Academy.

Your committee is pleased to announce that the Junior Section has been able to meet all the expenses incurred during the fiscal year. We are able to do this in large measure because of the excellent co-operation received from the various organizations of science teachers in the state. We appreciate the subsidy voted us by the Council for furthering our work to meet any deficit that might occur. It has been the dream of the founders of the Junior Section to have it become self supporting and it is with considerable pleasure that we can include this in our report.

(Signed) A. F. Cockrum, *Chairman*

WINNERS OF AWARDS

Best exhibit in all branches of science: Granite City Vocational Science Club.
Best display of Conference Theme: Granite City Vocational Science Club.
No awards were made in the Junior High School division.

Newsletter

PRINTED

1. Maine Township High School

MIMEOGRAPHED

1. Granite City Vocational Science Club
2. Visitation High School and Kankakee High School, tied

DITTOED

1. West Chicago High School

Physics

Best prize: J. Sterling Morton High School, Cicero

Individual	*Group*
Posters	
1. Visitation High School (33)	1. J. Sterling Morton High School (16) 2. Visitation High School (32) 3. Visitation High School (30)
Projects	
1. Morton High School (18) 2. Morton High School (17)	1. Morton High School (20) 2. East St. Louis High School (73) 3. Morton High School (19)

Commercial Products

1. Granite City High School (89)
2. Morton High School (21)

Scrap Books

1. Morton High School (22)
2. Morton High School (23)

Geology

Best prize: Bloomington Geology Club, Bloomington

Individual	*Group*
Posters	
1. Bloomington High School (68) 2. Bloomington High School (69)	
Projects	
1. Bloomington High School (71) 2. Bloomington High School (67) 3. Visitation High School (28)	1. Dupo High School (61) 2. Bloomington High School (70) 3. Dupo High School (60)

Collections

1. Granite City High School (93)

Chemistry

Best prize: Maine Township High School Chemistry Club

Individual	*Group*
Posters	
1. Peoria High School (77)	1. Peoria High School (76)
2. Maine Township High School (75)	2. Visitation High School (3)
3. Visitation High School (2)	3. Visitation High School (5)
Projects	
1. Maine Township High School (77)	1. Maine Township High School (82)
2. Maine Township High School (78)	2. Visitation High School (6)
3. Maine Township High School (79)	3. Pittsfield High School (41)
Commercial Products	
1. Pittsfield High School (40)	1. Pittsfield High School (42)
2. Bloomington High School (96)	2. Pittsfield High School (35)
3. Normal High School (123)	3. Bloomington High School (97)

Scrap Books

1. Granite City High School (87)
2. Visitation High School (13)

Biology

Best prize: Bloomington Biology Club

Individual	*Group*
Posters	
1. Bloomington High School (45)	1. Bloomington High School (51)
2. Peoria High School (73)	2. Bloomington High School (46)
3. Peoria High School (72)	3. Bloomington High School (50)
Projects	
1. Morgan Park High School (104)	1. Bloomington High School (44)
2. Morgan Park High School (103)	2. West Chicago High School (55)
3. Morgan Park High School (101)	3. Morgan Park High Cchool (100)

Commercial Products

1. Bloomington High School (49)
2. Bloomington High School (48)

Collections

1. Maine Township High School (75)	1. Bloomington High School (43)
2. Peoria High School (74)	

Other Events

The afternoon was devoted to the meetings of the eleven sections of the Academy, which were held at the East St. Louis Senior High School.

The annual banquet of the Academy was served to about 125 members and guests at the Broadview Hotel. Following the banquet, an address was given by Dr. Harry R. Hoffman on "Psychiatry in the Criminal Court of Cook County."*

On Saturday morning, six excursions were provided for members and guests of the Academy. Dr. A. R. Kelly of the University of Illinois conducted an anthropological trip to the Cahokia Mounds Park. Dr. H. S. Pepoon of the State Natural History Survey conducted a trip to the Missouri Botanical Gardens, in St. Louis. Dr. M. M. Leighton, Chief, State Geological Survey, conducted a geological trip, in which visits were made to the edge of the Illinois coal field, near

* Abstract to be published in Vol. 26.

Belleville, the Dupo oil field, a limestone mine near Valmeyer, and other points of interest. Dr. Lewis F. Thomas of Washington University, St. Louis, conducted a trip for the study of "The Water Factor in the Environment of East St. Louis." Industrial trips through the Monsanto Chemical Works, the Cahokia Power Plant, and the East St. Louis meat packing plant of Swift & Company, were also made possible by the courtesy of companies operating these plants.

REPORT OF THE TREASURER

For Year Ending May 2, 1933

Receipts

Balance on hand April 30, 1932		$565.06
Initiation fees and dues		706.00
Allowance from A. A. A. S.		221.00
Sale of Transactions		10.50
Interest on bonds and savings		28.23
Junior Academy		58.50
		$1589.29

Expenditures

Expenses of 1932 annual meeting:		
Programs	$23.24	
Expenses of section chairmen	6.52	
Expenses of officers	10.64	
Registration, badges, etc	66.77	
Telegrams, postage, etc	5.07	
		$112.24
Junior Section		81.08
Expenses of Secretary's Office		111.62
Secretary's salary		150.00
Editing *Transactions*		102.40
Postage on *Transactions*		19.39
Expenses of Treasurer's Office		76.85
Membership campaign		100.00
Expenses of Council meetings		21.10
Balance in University State Bank		814.61
		$ 774.68
		$1589.29

Resources as of May 2, 1933

Balance in University State Bank	$814.61	
Mortgage bond	600.00	
Accrued interest	15.00	
Office supplies	10.00	
Total resources		$1439.61

In presenting the above report the Treasurer would direct attention to the fact that there are bills outstanding for printing that will reduce the balance for the year by perhaps $250.00. In spite of this the actual balance for the year is at least equal to that of last year. This has been accomplished by decreased expenditure in several items, for the income from dues during the past year was $206 less than during the year 1931-32.

The present membership of the Academy consists of 86 life members, 503 members who have paid up to and including 1933, 281 members who are in arrears for one year, 152 who are in arrears for two years, and 51 who are in arrears for three years.

These last will be dropped at the date of this annual meeting. On May 2 there had been 49 new members added to our ranks during the year. Two annual members have been transferred to life memberships. Three members have been lost by death. The net membership on May 2, exclusive of those to be dropped at the present meeting but including the paid up new members, is 1070 personal members, 17 scientific societies, and 63 high school clubs.

The entire report is respectfully submitted.

(Signed) Geo. D. Fuller, *Treasurer.*

REPORT OF THE AUDITORS

We, the committee appointed to audit the report of the Treasurer of the Illinois State Academy of Science, have examined the Accounts, which appear to have been correctly kept, and have verified the entries of expenditures against approved vouchers made by the President and the Secretary. We find the cash balance of $814.61, and the Mortgage Bond of $600.00 as reported May 2, 1933, to be correct. (Signed)

Scott V. Eaton
J. M. Beal
A. C. Noé

REPORT OF THE LIBRARIAN

During the year there have been many requests for the *Transactions* from libraries in the United States and a few from foreign countries. These requests have been filled as have also a number of inquiries from manufacturing concerns relating to specific articles contained in the *Transactions* along their particular line.

Of Volume 23 numbers 2 and 3 are completely exhausted with only a few left of numbers 1 and 4. Of Volume 24 numbers 3 and 4 are exhausted.

It is to be regreted that because of the financial condition of the State it was not possible to publish any *Transactions* of the Academy during the past six months. I am very strongly in hopes, however, that the new budget, to take effect July 1, will take care of at least part of the publications of the Academy.

(Signed) Arthur Sterry Coggeshall, *Librarian.*

REPORT OF THE COMMITTEE ON PUBLICATIONS

The Publications Committee wishes to report that the reports of officers and committees made at the Twenty-fifth Annual Meeting were published as Volume 24, No. 4, from the State Appropriation, at an expense of $140. The copy for the first number of Volume 25, containing papers presented at the general sessions, council minutes, the constitution, and lists of officers, committees and members, and of the second number, containing the papers presented in the section meetings were sent to the State Museum in September, 1932, and estimates respectively of $165.00 and $1725.00 were obtained for these. Due to a shortage of state funds at this time, the requisition for printing these numbers was not approved. The copy was retained in Springfield, and a second requisition was prepared and submitted late in December, 1932. This requisition, like the first, was not approved, because of the lack of available funds, though the cost was less than the $2000 appropriated to the Academy. As the condition of the state treasury has not improved since this time, it has not yet been possible to arrange for the publication of these numbers. The preliminary program for the Twenty-sixth Annual Meeting was printed by the Academy at an expense of $30.00, as Volume 25, No. 1. At the request of the Council, the copy for the two numbers which should have preceded the program, was returned to the editor, and estimates have been obtained from several commercial printers. The lowest estimate thus far is $175.00 for the smaller number, omitting the membership list. This is considerably in excess of the state's estimate. The lowest estimate thus far obtained for the larger number

is slightly less than the $1725.00 estimate of the State Printer. The committee plans to place a contract for the publication of the smaller number in the near future.

The present emergency may require the adoption by the Academy of a revision in its publication policies. Several alternative policies may be briefly mentioned: (1) an increase in the annual dues paid by members, so that these dues would cover the costs of publication; (2) the placing of an additional charge for the annual *Transactions*, which have previously been sent to all paid up members, so that the sales of *Transactions* would cover the cost or printing them; (3) a great reduction in the size and cost of the *Transactions* through the publication of only brief abstracts of the scientific papers presented at the meetings; (4) reduction in the size of the volume by greater censorship of papers submitted for publication, or by a decrease in the number of sections of the Academy holding independent meetings. The committee has been informed that the Academy conference of the A. A. A. S. supported the third policy, with the plan to publish, at a future date, the papers submitted, if funds for their publication should become available. The committee would welcome from any of the members of the Academy suggestions for the solution of this problem.

(Signed)

HARRY F. FERGUSON
HAROLD R. WANLESS
LYELL J. THOMAS

REPORT OF THE EDITOR

Printer's copy for the last number (June issue) of Volume 24 and the first two numbers (September and December issues) of Volume 25 were submitted to the State Division of Printing last July. The June issue was distributed in October, 1932, and was accompanied by a notice explaining that the delay in printing the papers presented at the Twenty-fifth Annual Meeting in Chicago was due to shortage of state printing funds.

The announcement of the coming Annual Meeting, normally No. 3 of a volume, was finally printed as No. 1 of Volume 25 in March, 1933, at Academy expense. At the request of the Council, copy for the other two issues was returned to the Editor and has been submitted to commercial printers for estimates. The orders have not yet been placed but it is expected that the small number will be printed shortly.

The brief pamphlet "Suggestions to Authors," has been revised and mimeographed copies have been distributed by the Secretary to those presenting papers at the Twenty-sixth Annual Meeting.

Respectfully submitted,

(Signed) DOROTHY E. ROSE

REPORT OF MEMBERSHIP COMMITTEE

In the current membership campaign, an earnest attempt has been made to secure new members, especially in the recently organized sections of Agriculture, Anthropology, and Economics. Also, an effort was made to swell the list of life members of the Academy. The results of the campaign, as a whole, were somewhat disappointing—a reflection, probably, of the prevailing economic conditions.

The Council of the Academy appropriated the sum of $125.00 to be used for the membership campaign, cost of which was $94.52.

Respectfully submitted,

(Signed) DON L. CARROLL, *Chairman*

REPORT OF THE COMMITTEE ON ECOLOGICAL SURVEY

The citations in the bibliography of Illinois ecology have now been brought into uniform arrangement and new titles are being added to complete the work

to the end of 1932. Material is slowly accumulating for the committee's other project, the guide to Illinois localities of ecological interest.

Respectfully submitted,

(Signed) A. G. Vestal, *Chairman*

REPORT OF THE COMMITTEE ON HIGH SCHOOL SCIENCE CLUBS

The High School Science Clubs Committee held its first meeting during the High School Conference at the University of Illinois. At this meeting, it was decided to canvass particularly the down-state schools for new members. A Geology group was added to induce the affiliation of schools heretofore not members of the Junior Section. Two hundred schools were mailed information concerning the Academy and its functions. The response from these schools was very gratifying to the committee.

The very nature of our organization with the committee members residing in various parts of the state has prevented the committee from meeting as a unit. However, the work has been carried out by means of correspondence and several meetings of small groups of our committee.

Your committee of this year has attempted to keep the expenditures well within the budget set us by the Senior Academy Council. We are pleased to report that at the present time we have expended less than the actual amount collected from the affiliated clubs. We appreciate the fact that the Council voted us a subsidy to carry out our program but thus far we have not had to take money from the fund. We believe that the Junior Section can be self-supporting under the guidance of the Senior Council.

We wish to thank all those people who helped us with the work this year and especially to thank the Senior Academy Council for its splendid cooperation with us.

(Signed)

A. E. Cockrum, *Chairman*
Mabel Spencer
Louis A. Astell
Karl Schatz

REPORT OF THE COMMITTEE ON STATE HALL OF FAME

On account of the acuteness of the depression, it has been impossible to do anything on this subject . It is recommended, however, that the Committee be continued in order that this matter may have attention as soon as conditions warrant.

The Committee has lost a valuable member through the untimely death of Professor U. S. Grant. This vacancy should be filled.

(Signed) M. M. Leighton, *Chairman*

REPORT OF THE DELEGATE TO THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Minutes of the Atlantic City Session of the Academy Conference

The Atlantic City session of the Academy Conference was held in the Haddon Hall Hotel on December 28, 1932, at four o'clock. The chairman, Dr. A. C. Walton (Illinois Academy) called the meeting to order. In the absence of the secretary, S. W. Bilsing (Texas Academy), the chair asked Dr. Mary T. Harman (Kansas Academy) to serve as secretary *pro tem.*

The secretary read the minutes of the New Orleans session of the Academy Conference, which were approved, after which Dr. H. E. Enders (Indiana Academy), vice-chairman, was called to the chair.

By unanimous vote, Dr. Emmett B. Carmichael (Alabama Academy) was

elected vice-chairman for 1933, to become chairman for 1934. Dr. Enders then automatically became chairman for 1933.

Dr. S. W. Bilsing (Texas Academy) was unanimously elected secretary of the Conference for the ensuing four-year term.

Dr. A. C. Walton (Illinois Academy) read a paper on "A survey of the various academies as to the policy of their publications." A discussion followed Dr. Walton's paper, in which policies and practices of some of the academies in regard to their publications were explained.

Dr. Otis W. Caldwell, chairman of the Committee on Junior Academies of Science and related activities, reported on "The junior academy movement in the various states."

Leading the discussion following Dr. Caldwell's report Dr. Enders spoke of the design for the pin adopted as insignia by the Illinois and Indiana Junior Academies. This has the shape of the geographical outline of the state represented, in enamel on gold, or other suitable material. Dr. Enders showed a sample of the pin, also a card bearing a picture of the pin with notation concerning prices. A general discussion followed. The Academy Conference voted to recommend that those states in which there are junior academies might well follow the plan of Illinois and Indiana with reference to insignia; that is, that the pin be in the shape of the state represented and that the guards be the same for all states. Dr. Enders will be glad to furnish further information by correspondence.

The chair then called for brief reports from the representatives of academies that were sponsoring junior academies. The following speakers responded: A. C. Walton (Illinois Academy), H. E. Enders (Indiana Academy), Joseph Gilman (Iowa Academy), Mary T. Harman (Kansas Academy), R. A. Budington (Ohio Academy).

The session adjourned to the dining room to continue these reports and the four speakers named below took part: P. E. Strausbaugh (West Virginia Academy), Emmett B. Carmichael (Alabama Academy), E. C. L. Miller (Virginia Academy).

A manuscript report on this subject was subsequently received from Dr. Budington, which is quoted below.

"As a beginning, 37 High Schools, accredited by the North Central Association were canvassed; 23 reported science clubs already operating. Encouragement was offered them by furnishing lists of projects, and suggesting correlation of effort. Principals and superintendents seemed cordial in their correspondence. Care was taken to indicate that no new clubs were suggested, the idea being to aid existing clubs to increase their effectiveness; a common remark was that the schools were already over-organized. An attempt was made to hold a regional rally and Demonstration Day, in the area just west of Columbus; High Schools in five near-by cities agreed to participate. So far as it went, this seemed to be a success. It appeared that headway in this sort of thing must be accomplished in small regions, the schools of each region acting according to their own inclinations; it is suggested that academy members in each of such regions might take the initiative; the difficulty is to find enough leaders who are enthusiastic, interested, and willing to contribute time and incur expense in this sort of service. For the present, the Executive Committee of this Academy is not able to finance and follow up this work, although it seems a very good thing indeed."

The session requested the secretary *pro tem.* to send a night-letter telegram to Dr. Bilsing, expressing regret on account of his unfortunate absence and congratulating him on his re-election to the office of secretary of the Conference. This was afterwards done.

It was suggested that the representative of the Iowa Academy, Dr. Joseph C. Gilman, investigate the question of qualifications of Junior Academy leaders, and report at the Boston session of the Conference next year.

A rising vote of thanks was extended to the American Association for the

Advancement of Science for the excellent arrangements for this session and for the complimentary Academy Dinner.

This Conference session adjourned to allow its members to attend the opening session of the Atlantic City meeting of the A. A. A. S.

(Signed)

MARY T. HARMAN, *Secretary pro tem.*
A. C. WALTON, *Delegate*

REPORT OF DELEGATE TO THE CONSERVATION COUNCIL OF CHICAGO

Since our last annual meeting one year ago the Orland Wild Life Preserve of Cook County has been definitely established.

Reports of new National Parks, National Monuments, National Forests, as well as increases in the state forests and state parks continue to pour in. The establishment of the Great Sand Dunes National Monument which sets aside the largest dunes in the United States (California), Superior National Park in Northern Minnesota, and the Everglades National Park are of great interest.

Among the plans for the continued development of forests by the states the New York plan is noteworthy; it provides for acquisition and reforestation of one million acres of land over a period of fifteen years. This involves the expenditure of twenty million dollars. In this connection it must be remembered that New York already has a system of state parks and forest preserves unequaled anywhere, including 4½ million acres in the Adirondack region and 600,000 acres in the Catskills.

The economic survey by counties in northern Michigan furnishes a basis for future development of conservation in that state. The forestry movement has advanced rapidly in Michigan because much of the land is returning to the state for nonpayment of taxes. It is estimated that the 2½ million acres of forestlands now held by the state will eventually be increased to at least five million acres.

By a unanimous vote of the twenty-four delegates present at the January meeting of the Conservation Council the following plan for Illinois was recommended:

(1) The Department of Conservation to be administered by a rotating commission, to serve without pay, of preferably five members appointed by the governor. This commission shall include outstanding biological faculty members of leading Universities. This commission shall appoint the directors of the department.

(2) Contingent upon the adoption of the foregoing, we recommend the transfer of state parks from the Department of Public Works and Buildings to the Department of Conservation.

The above recommendations are believed by the Council to be necessary in order to insure the preservation of the scenic beauty, our forests, our rivers, and our fish and game preserves, free from political and economic greed, and at the same time make possible new developments on a scale sufficiently large that our people may enjoy the great outdoors throughout the coming centuries.

REPORT OF THE COMMITTEE ON RESOLUTIONS

I Since the last meeting of the Academy of Science, three members— U. S. Grant (the first President of this Academy), J. Paul Goode, and Abel McAllister have been lost through death.

(1) *Resolved*, That the Academy express its feeling of direct loss in the death of these respected members. Be it further

(2) *Resolved*, That the Council designate members to prepare worthy necrologies of these men to be published in the Academy publication.

II Whereas the future success and growth of this Academy is recognized as resting in the hands of the coming generation of scientists, therefore, be it

(1) *Resolved*, That this body express its appreciation of and interest in the growing participation by the Junior Section in the annual program, and be it further

(2) *Resolved*, That the High School Science Clubs be commended for the excellent displays of work and projects with their many applications in teaching and in public education.

III Whereas the present conditions of stress and strain have thrown upon the members of the Council of this Academy unusual duties and have raised many difficult problems, be it

(1) *Resolved*, That the Academy extend a special word of thanks to the members of the Council for the judicious guidance of the affairs of the organization during the past year. Further be it

(2) *Resolved*, That the Treasurer, Dr. Fuller, be particularly commended for the wise administration of the finances of the Academy.

IV Whereas this Academy has at an earlier meeting adopted resolutions concerning the establishing of National Forest Units in the State of Illinois, be it

(1) *Resolved*, That the Academy assembled in Annual Meeting on May fifth, 1933, reaffirm its interest in and active support of a policy looking toward the development of forestry conservation within our State. Be it further reaffirmed that this Academy stands ready to offer its support to both State and Federal agencies in furthering the establishment of adequate programs of forest conservation.

V As a body of more than one thousand persons interested in science, the Illinois State Academy of Science takes this opportunity to affirm its interest in and concern for the welfare of all scientific work of the various State agencies. Be it therefore,

(1) *Resolved*, That this body go on record as endorsing the past and projected program of research and studies carried on by the various educational and scientific organizations under State Direction. Be it further

(2) *Resolved*, That the State Legislature be urged to continue to extend adequate financial support to these organizations. Be it further

(3) *Resolved*, That the Legislative Committee of this Academy be instructed to work for all matters of legislation favoring these agencies and to oppose all untoward legislation threatening the progress of education and of science in the State.

VI Whereas the efficient and painstaking care of the local committee under the chairmanship of Frank L. Eversull has provided convenient arrangements and well coordinated plans for the various sessions of the Annual meeting, therefore, be it

(1) *Resolved*, That this Academy express its appreciation of the careful planning and generous hospitality which have contributed so greatly to the success of this meeting. Further, recognizing that close co-operation between the council, the local committee, and various other interested persons and agencies contribute to the smooth operation of our business and scientific sessions, be it further

(2) *Resolved*, That the Academy express its appreciation of the wise planning and co-operative effort of all the varied groups entrusted with details of plans and arrangements.

(Signed)

HARLEY J. VAN CLEAVE, *Chairman*
GEORGE EKBLAW
ARTHUR C. WALTON

TRANSACTIONS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

VOLUME 25 JUNE, 1933 NUMBER 4

Papers Presented in the Twenty-fifth Annual Meeting, Chicago, Illinois May 6 and 7, 1932

EDITED BY DOROTHY E. ROSE

Printed by authority of the State of Illinois
DEPARTMENT OF REGISTRATION AND EDUCATION
STATE MUSEUM DIVISION, CENTENNIAL BUILDING
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EDITOR'S NOTE

The articles and abstracts in this volume of the TRANSACTIONS are printed without author's corrections.

Papers In Agriculture

Extract From the Report of the Section Chairman

The program for the first meeting of the Agriculture Section consisted of five articles which dealt with different aspects of the general topic, "Recent Changes in Food Habits and their Causes." All of the papers were presented at the meeting but abstracts of only three are herein published. The others were:

"Recent Changes in Food Habits Caused by Developments in Processing," by F. M. Simpson, Commercial Research Department, Swift and Company, Chicago.

"Changes in Food Distribution and How They Affect the Consumer," by E. L. Rhodes, The Food Trades Publishing Company.

Attendance at the section meeting averaged thirteen; maximum attendance was seventeen.

The acting chairman, Dr. H. W. Mumford, University of Illinois, was elected chairman for the year 1932-1933.

(Signed) H. W. Mumford, *Chairman*

RECENT CHANGES IN FOOD HABITS

BY

SYBIL WOODRUFF

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ABSTRACT

Eating habits with respect to form of foods and manner of preparing them have undoubtedly undergone much change over the past several years. Such change has a bearing upon the biological values of foods, upon the esthetic satisfaction afforded, and upon cost even though it does not lend itself to statistical treatment. Changes in these intangible factors probably equal or exceed the importance of shifts in quantity consumption.

Although the American diet is made up of about 100 different foods, approximately three-fourths of the calories come from a dozen or so major items and all can be assigned to six groups. This paper has brought together figures showing changes in quantity consumption for these groups or for important representatives of them and has pointed to the possible influence of these changes upon the nutritive value of the nation's diet.

Great diversification in kind of food in late years has been one evidence of a relatively high income and standard of living. There is, however, a physiological limit to the amount of food a person can consume; therefore if one item of food is consumed in greater quantity it is at the expense of another. These points are well illustrated in the group of fruits and vegetables where there has been during the past ten years a manifold increase in the use of several such items as spinach, head lettuce, and grapefruit. Early figures on total vegetable and fruit consumption are unfortunately too incomplete to substantiate the general impression that their use has measurably increased over the past thirty years. The consumption of milk, as fluid milk and its products, has increased steadily although meats *in toto* have shown little change over the past thirty years. Fats and oils have shown a slight rise and sugar a very marked one in the same period. The consumption of grain foods and flour has fallen off noticeably during the years when other foods mentioned have come into greater prominence.

It would be gratifying to know that the national diet has improved in quality and in nutritive value as it has become more diversified. Analyses in the past of diets of groups of people representing different occupations have shown little if any margin of safety in some of the mineral nutrients and probably in certain vitamins. The tendency toward a greater use of vegetables, fruits and milk during the past thirty years is commendable because it is in the direction of safeguarding those nutrients.

INFLUENCES OF CHANGES IN PRODUCTION ON CONSUMER FOOD HABITS

BY

L. J. NORTON

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For a foodstuff to obtain a fixed place in a diet of a population, four things are essential: (1) it must be a relatively economical source of some utility which is recognized by consumers; (2) production must be organized so that it is available in adequate quantities and at prices which appeal to consumers; (3) commercial distribution must be organized to provide for regular and economical distribution; and (4) a considerable number of people must have become habituated to its use.

The idea of change in food habits is comparatively new. Under conditions of difficult transportation, most people consumed the commodities native to the locality or geographical area. Foods habits, which thus tend to become fixed, are carried with people when they emigrate. Under modern conditions, which permit a wide variety of foods to be available, the existence of population groups with differing food habits gives rise to demands for a wide variety of products in such a country as the United States.

Cheapening of transportation tends toward nationalizing and internationalizing of food materials. High transportation costs and inefficient distribution systems are bars to this widening. The maintenance of the level of transportation costs at a time when prices and incomes are falling, as occurred in 1929-1932, tends to greater localization of food supplies.

The change in consumption of individual classes of foods and their relation to production are briefly summarized:

Milk and Dairy Products.—The increased consumption of milk which had taken place for some years up to the beginning of the current depression was influenced greatly by improvements in quality. Basic to this was the adoption of pasteurization for large city milk supplies. Increased real incomes in the period following the War was an important factor in the increased consumption. This increased demand required a complete reorganization of the production end of the industry. Production per cow has been greatly increased through breeding, better feeding, and better care. The expansion in demand for butterfat has made necessary the development of dairying of an extensive type in new areas. In general, changes in production and production methods resulted from changes in demand and consumption.

Meats.—It should be noted that an analysis of changes in consumption of the different kinds of meats is complicated by cycles in production which characterize the different species of domestic animals. We consume what we produce with some modification for changes in storage stock, in imports of cattle and beef, and in exports of pork. Price changes adjust consumption to altered supplies. The consumption of beef per capita has now declined or been about stationary for several years, due to the position of the industry in its cycle. Actually numbers of cattle have been increasing for three or four years and as soon as marketings are increased, consumption will expand.

Leaving cycles out of consideration, there has been but little tendency for meat consumption in the United States to change over the last twenty years. More pork and somewhat less beef is being consumed. This probably reflects the fact that hogs can convert grain into meat more economically than can cattle, that relative prices cause pork to be more attractive to consumers, and that relative profits cause hogs to be more attractive to producers. Two trends are to be observed in beef production: First, changes in methods of production stimulated by consumer preferences cause production of increased numbers of lighter weight, younger animals; second, growth of the dairy industry yields an increased quantity of low-grade beef.

The increase in the available supply of pork in the year immediately following the War was caused by a series of large corn crops from 1919 to 1923. The subsequent large volume of production does not reflect large crops of feed grains but rather the diversion of corn from feeding work animals and as a human food to the production of pork and the increased efficiency of production due to lower losses from disease and better all-around management. Decreasing exports have also made more of the total supply available for the home market.

The increase in consumption of lamb in the last two years is a cyclical phenomenon. Sheep flocks have been built up and marketing increased. The price has lowered relatively and consumers have adjusted their buying practices to the changed supply.

Cereals.—Production is not a limiting factor in the consumption of any cereal product used as human food in the United States. We have a surplus above domestic food requirements of all cereals commonly used in this country as food. The decline in per capita consumption of wheat and corn in the United States, which has occurred over the last thirty years, cannot be explained by any change in production. Historically hard wheat replaced soft wheat to a large extent as a source of the bread flour used in this country. This was made possible by the large areas of semi-arid land adapted to production of hard wheat, the invention of suitable milling machinery, and the development of farming methods and cultural practices for the economical production of wheat in these areas.

Vegetables.—In recent years there has been a rapid expansion in the consumption of vegetables. Vegetables may be divided into two classes: first, those like potatoes for which the demand is relatively fixed; second, those like lettuce for which the demand is quite flexible. The production of the first class is largely governed by the demand subject to large seasonal differences caused by variations in yield per acre and some tendency toward cyclical changes in acreage consumption tends to be quite fixed. The consumption of the second class is influenced by availability and may be rapidly expanded as production is developed. The recent rapid expansion in consumption of vegetables of the second class is based on the following factors: (1) the development of refrigeration in transit; (2) the development of production in areas remote from consumption centers which made possible a perennial fresh supply; (3) availability in a large variety of stores where they are sold by display; (4) increasing recognition of the dietary value of vegetables, the search of consumers for flavor, and higher real incomes which made possible a more varied diet.

Fruits.—Consumption of fruit is influenced by production over considerable periods of time, because of the long production period required. Production, and hence consumption, of citrus fruits has expanded rapidly in recent years. Consumption of apples has not similarly increased because

the trend in production has not been upward. The rapid increase in consumption of bananas reflects the influence of large scale plantation production and a very efficient distribution system.

Fats and oils.—A rapid increase in output of a number of kinds of fats and oils in recent years has created a surplus above ordinary food requirements.

Sugar.—With the development of large scale plantation production of cane sugar and technical improvements in beet sugar production, particularly in Europe, the cost of sugar has been greatly lessened and its consumption has very rapidly expanded.

Importance of Dietary Standards to Agricultural Development.—Changes in food habits react on agricultural production. Decrease in consumption of cereals tends to lower the demand for them and their relative prices. The increases in consumption of milk, lettuce, and oranges have the opposite effects. The effect of such shifts is to weaken the economic position of producers and regions which produce the first type of commodity and strengthen the position of the second.

From a national standpoint the shift from cheap sources of foods like wheat to more expensive products like milk and vegetables means a more expensive diet, but one which makes it possible to utilize more people in the farming industry. With large numbers of people, who because of technological unemployment or because of the depression cannot find productive employment elsewhere, it is desirable that consumption of the foodstuffs which involve most labor be maintained. It is desirable that prices of these products be kept as low as possible in view of costs and that cheap methods of distribution be used so as to maintain consumption of them at as high a level as is possible. To this end all agencies involved in production and consumption need to cooperate.

INFLUENCE OF CONSUMPTION UPON CHANGED FOOD HABITS

BY

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Although consumption has been conceded an integral part of the whole economic structure, until recent years it has not been studied and analyzed. References to consumption in the text books of economics are still vague and lack the facts which are available (even though they are few) to make it convincing. The few cooperative ventures in buying have been a by-product of the producers' cooperatives and have made no such advances as have the mergers in production and distribution. The ultimate consumption, therefore, is scattered among the 20,000,000 or more families with little rhyme or reason other than traditional custom, personal tastes, and the influence the producers have been able to wield with high powered salesmanship and advertising campaigns.

VARIATIONS OF CONSUMERS' INCOMES

For the purposes of this discussion income is used in the sense of the value of money of the net receipts or gain accruing through a given period of time to an individual or family, which in turn is expressed in income as purchasing power consisting of net increase in power to obtain commodities which accrues to the individual consumer or family. This end is accomplished by dividing the money income by the index numbers of prices, thus giving the gain or loss in purchasing power experienced by the consumers' income.

King's 1915 study, in connection with the National Bureau of Economic Research, estimated the income of the people of the continental United States from 1850 to 1910. By 1910 the National income was fourteen times the 1850 value, the per capita share had trebled, and the average per capita purchasing power had more than quadrupled. The dollar's worth of purchasing power per capita in total increased about 30 per cent from 1909 to 1928. The 1930 study showed that there was a marked per capita increase from 1921 up to 1929. It indicated that the average American was better able by a third to buy consumption goods in 1927 than in 1921.

When the income of the family increases, the percentage spent for food becomes smaller, although the actual amount may grow larger. As a law of consumption this is now almost axiomatic, although the Chapin study in New York found the food expenditure remained about the same as the total expenditure increased. This was probably due to abnormal New York congested sections plus difference in sampling. Otherwise all American studies show a uniform tendency.

A number of quantity budgets of food that describe different standards of living show interesting trends when compared on the basis of percentage to various kinds of food consumed. A family cannot go on eating more food than it needs. It therefore turns to luxury types of foods or to a more generous and diversified diet. With an increase in money spent for food, the comparison of two standard quantity budgets at a lower and higher level shows a slightly reduced proportion going to meats, an appreciable increase in the milk and cheese, decreased amount spent on bread and

cereals, increasd amounts of fruits and vegetables, and decreased amounts in fats and sugar. Although the President's Conference on Home Building and Home Ownership report on substitute services in the home revealed no statistics available on the amount of home production of food, the increase in bakery foods and delicatessen products within the last ten or fifteen years shows a tendency to reduce home production of certain foods and an increased use of prepared products. Thus, though there is no mass of quantitative data to show diversification of dietaries as incomes increase, we know it is true and it is partly due to an increase in the consumer's available purchasing power making possible greater catering to human wants.

CHANGES IN THE MECHANISTIC AGE

Variations due to changes in the mechanistic age have influenced the mode of living and are reflected in food habits. With the definite hours, definite schedules, and more activity outside of the home there is less leisure for lingering over the meals. The influx of women into modern business and industry has undoubtedly had a marked effect upon food consumption both from point of view of the reduced time for food preparation in the home—and thus an increased purchase of ready prepared goods—and reduced help from family members. The introduction of labor saving devices in the tasks of the household has released the homemaker's time and energy for other things. Where in the past the display of cooking skill was a means of expressing "conspicuousness" of her family, the objects have changed to other forms of elaborateness in consumption, or in the case of food, to having meals out of the home.

INFLUENCE OF OCCUPATIONAL CHANGES

Occupational shift influences food utilization. As long as America was largely an agricultural country with pioneering hardships and much manual work there was a cause for greater per capita food consumption.

King has shown from his study of the period 1909 to 1927 that agriculture is the only industry in which fewer people were engaged in 1927 than in 1909. The "white collared" occupations increased at the expense of other fields.

What, then, is the relation of the occupational change to food consumption habits? With a shift to the "white collared" industries, the activities of the people are less strenuous, the lives more routinized, and the food needs of the body reduced. The first paper has shown the differences in nutritional needs due to occupational differences. This phenomenon occuring at the same time of increased incomes gives the consumer a greater opportunity to exercise choice in food selection and therefore tends to make him more discriminating.

The problems surrounding the differences in choices of food due to differences in race or nationality are not of as great importance in recent years as they were before the restriction of immigration by Federal legislation. In the main, dietary habits are remarkably fixed habits. Studies on the subject show that the immigrant's diet usually suffers when he comes to this country. He has come the cheapest way possible, has little available means, and is handicapped by a language deficiency, an ignorance of American foods, and higher cost of the foods that he has been in the habit of consuming. He usually settles in a neighborhood of his own country people which retards his learning of those American foods that are available or that are necessary for his new living conditions. By the second and later generations, the diet tends to become Americanized so that there is no appreciable influence of nationality upon the choices of foods. The

tendency to cling to characteristic national methods of preparing food is more pronounced than the tendency to cling to the native type of food.

Thus the national differences wield a less important influence upon changing food habits than might be supposed when viewed from the standpoint of differences between the fixed habits in the native country and the American customs.

INFLUENCE OF EDUCATION

The research in nutrition applied to human needs is of relatively recent development. The dissemination of such information is still more recent. As the experimentation has progressed, the importance of certain foods in the diet have been emphasized. This has in turn led to educational campaigns for increased utilization of these foods. An example is the need for and the use of milk. The health programs in schools, the free baby clinics, the programs for child development have all emphasized the need of milk in the diet.

There is little quantitative data available relative to the effect education has had upon food consumption. A publication by the Association for Improving the Condition of the Poor of New York City shows the influence education on foods needs has had upon food consumption of the families under their observation. This is not typical for the country since it is a selected locality and a small sample, yet it is indicative of the possible effects of education upon the food intake. The study shows the average distribution of expenditures of a series of families in 1914 and the same for 1928. The findings are expressed in terms of percentages spent on the various classes of foods, compared with the suggested percentage distribution, and further compared by influenced and uninfluenced families. The majority of uninfluenced families in 1928 spent a larger percentage of their food money for milk, fruits and vegetables and a smaller percentage for meat and fish than the corresponding uninfluenced families in 1914. All the influenced families showed a tendency to approach the suggested distribution by reduction of the percentage, if that percentage was over, and to increase if the opposite was true. Further, the results of the study showed the influenced families distributed their money among various types of foods in such a way as to obtain diets of higher food value at less cost than the uninfluenced families in a corresponding period.

It is impossible to draw general conclusions from one investigation, and yet it is probable that other studies would reveal like improvement such that it is fair to say that education has been a part of the cause for change in food selection.

As each of the factors discussed is a mingled part of the same whole, and as the quantitative data relative to each are meager, the above list simply suggests those which tend to have some influence upon changing food habits from the point of view of consumption.

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PAPERS IN ANTHROPOLOGY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

A symposium consisting of 14 papers on "Illinois Pre-history" comprised the program for the first meeting of the Anthropology Section. Articles by Messrs. Cox, Merwin, and Kinietz were read by title only, but all papers were presented for publication.

Attendance at the meeting, which was concluded on Saturday morning, averaged about fifty; maximum attendance was sixty.

Dr. A. R. Kelly, of the University of Illinois, was elected chairman for 1932-1933.

(Signed) A. R. KELLY, *Chairman*

FIELD METHODS EMPLOYED IN MISSISSIPPI VALLEY ARCHAEOLOGY, WITH SPECIAL REFERENCE TO THE WORK IN ILLINOIS

BY

FAY-COOPER COLE

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ABSTRACT

This paper presented in a brief manner the methods used by the professional archaeologist in recovering the pre-history of the State.

The first step is to know just what has been done and what sites still remain for examination. The survey party arrives in a township and soon learns who among the local people are interested in Indian relics. Usually there are several and their collections are carefully studied, divided into types, and recorded. Such collectors are usually valuable assistants in locating and placing on the map all known Indian mounds, camp and village sites, quarries, and the like. Such a survey reveals the various cultures of the region, their location and extent, and indicates favorable sites for excavation.

If a mound is to be excavated, soil tests are made on all sides and it is then staked into five-foot squares. A long trench is then started on one side and the face of the mound is shaved away with light mattocks until a find is made. All skeletons, pots, and other materials are uncovered but are not disturbed until repairs are made, notes and pictures secured, and their exact position determined by planetable survey. In this manner it is possible to record any trace of stratification in the mound or other evidence of a sequence of cultures.

When a mound is to be tested to determine whether it is an artificial or a natural formation, a narrower trench may be started at the side. If evidences of human origin are encountered the trench may then be widened to include the whole structure. The use of pits and of post-hole testing are to be discouraged as both methods are apt to destroy valuable evidence, and have often failed to tell the true character of the site.

Much the same procedure is practiced in ancient house pits and even in village sites. In the latter, however, large squares are often selected and the earth is removed in six-inch levels. In general the methods outlined in the Guide Leaflet No. 93, published by the National Research Council, are recommended.

By such methods, it has been possible to carry the pre-history of Illinois back step by step for at least two thousand years and possibly for five thousand. At one site near Joliet, it has been demonstrated that at least three different Indian cultures are shown in the mounds and still another below them. On Illinois River three successive cultures have been established on the bluffs while it is shown that ancient peoples with long heads buried their dead in the sands centuries before a mound-building people placed their burial mounds above the same site.

Illinois is now known to be an exceedingly important state archaeologically; it has been long inhabited by Indian tribes of very different cultures, and it possesses some monuments of great interest. This story is now being recovered by the exact procedure of the scientist who seeks all the information a site may possess rather than the few trophies it may contain.

SOME OBSERVATIONS ON THE ANTIQUITY OF MAN IN ILLINOIS

BY

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ABSTRACT

The systematic work which archaeologists have recently done in the excavation of Indian mounds in Illinois has revealed additional information with regard to the antiquity of man in this State. The line of evidence of greatest use in analyzing this question is the profile of weathering which the mounds show. Most of the mounds have poorly developed profiles. The soils are thin and the amount of natural differentiation and the weathering is slight. The rate of profile development is not definitely known, but the mounds are known to be pre-Columbian in age, that is to say, more than 400 years old. The youngest glacial drift-sheets in Illinois are thirty to thirty-five thousand years old and they show leaching to a depth of 2½ to 3 feet, oxidation to a depth of 6 to 9, a well developed humus horizon with its own structural elements, grading below into a sub-soil zone which has become plastic, due partly to filtration of colloidal particles from above and partly to weathering of materials in place. Such profiles are regarded by geologists as youthful, in spite of their being thirty to thirty-five thousand years old. Therefore, it would seem that the time required for any appreciable development of a profile of weathering would be more than a few hundred years.

A few such instances have been found, one of them on a terrace in Illinois Valley near Utica, excavated by Dr. A. R. Kelly of the University of Illinois. The profile of weathering on this mound stood out in contrast with other mounds that had been excavated in that it possessed a well developed soil over it and graded downward into a dense, compact sub-soil horizon. My impression was that this profile required something like two or three thousand years to develop.

Another mound near Liverpool, Illinois, of considerable age was brought to my attention by Dr. Fay-Cooper Cole, of the University of Chicago, who was carrying on systematic excavation here. In this case, the mound showed two stages of development. The lower portion of the mound possessed a soil horizon with some fairly definite structural elements separating it from the overlying mound. As a result of a conference attended by Dr. Cole, Dr. Rollin T. Chamberlin and myself, the lower portion was estimated to be at least two thousand years old and possibly five thousand.

On the second plat of the Mississippi River flood-plain in Jackson County, a mound was excavated last summer by Dr. Kelly which showed certain relations to an overlying deposit of alluvial fan material and certain weathering characteristics that impressed the writer as being considerably older than other mounds of that region, possibly two thousand or more years old.

A critical attitude should continue to be maintained on evidences pointing to the antiquity of man in Illinois in connection not only with Indian mounds but in caves, shelters in glacial gravel deposits, and in inter-glacial soil horizons.

LOCAL TYPES AND THE REGIONAL DISTRIBUTION OF POTTERY-BEARING CULTURES

BY

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This report sketches briefly late archaeological activities in Wisconsin with specific regard to pottery types, their distribution, and the extent to which they have helped establish our present opinions on the classification and distribution of cultures. Comparisons are attempted with neighboring and other related areas to show the indications of wider regional manifestations of local phenomena.

Collections of potsherds obtained from camp and village sites scattered throughout Wisconsin contain at least two easily distinguishable types of pottery: (1) a rough, grit-tempered, cord-imprinted ware, named the Lake Michigan, and (2) a smooth, shell- or cell-tempered, incised ware, frequently equipped with loop-handles, named the Upper Mississippi. The first type is the more common and might be described as characteristic.

Lake Michigan culture.—The first intensive research in Wisconsin was concerned with the excavation of a compact group of effigy, conical, and linear mounds which were apparently the product of a single culture and are tentatively accepted as typical for the "Effigy Mound culture," probably a variant or subtype of the Lake Michigan culture. The pottery was rough, granular, low-fired ware, tempered with grit, decorated primarily with imprints from a cord-wrapped paddle, but with examples of a secondary intaglio ornamentation executed by means of cord-wrapped implements or, more rarely, by means of incising or indenting, the forms varying slightly from a single *olla*-shaped pattern. The absence of indications of European contact (such as glass beads and implements of iron, brass, or silver), warranted the tentative conclusion that the culture flourished in a locally prehistoric period.

Habitation sites on the Menomini Reservation, a region long occupied by the Menomini Indians, yielded materials illustrative of a practically pure culture complex including the Lake Michigan pottery industry. The widespread prevalence of Lake Michigan pottery in Wisconsin may then reflect the equally widespread dominance of a basic culture largely common to the ancestors of the historic Algonkins of this province, comparable to the known historic dominance of the linguistic and cultural stock.

Aztalan culture.—The Aztalan culture complex, the second to be determined in Wisconsin, was encountered at the Aztalan village site in the south central part of the state and differs markedly from that of the Effigy Mound culture. Aztalan pottery is relatively superior. The tempering is generally of shell; the paste for the best grade of ware is thoroughly mixed and of uniform texture; surfaces are smooth; the hardness varies between a fairly soft utilitarian product and a finer ware of maximum hardness for a low-fired product; shapes are various including vessels with angular shoulders, hemispherical bowls, bird-effigy bowls, bowls with contracted rims, shallow platters, vessels with handled covers and gourd-shaped ladles; both vertically placed loop-handles and laterally directed tab-handles are represented; entire surfaces or certain limited surface areas are covered with a red paint or slip or are dyed black; the

best of the black ware is highly burnished; geometric intaglio patterns include both straight and curved linear motifs.

An original deposit at Aztalan illustrating the Lake Michigan culture had been so disturbed and mixed with other detritus, due to cultivation, that the stratigraphic record has been lost, but a number of transitional potsherds that show mixed Aztalan and Lake Michigan influence illustrate lateral gradation and indicate that the two archaic groups were to some extent contemporary.

Upper Mississippi culture.—The third or Upper Mississippi culture was first encountered at a habitation site and associated group of low semispherical mounds. The pottery industry, which was well developed, was represented by many sherds and a number of entire vessels. This ware, illustrating the second most common pottery type found in the state, is characterized chiefly by such traits as shell tempering, flaky texture, light weight, smooth surfaces, roughly incised decorations employing a repetition of simple geometric motifs, shapes including hemispherical bowls, round-bottomed vessels often equipped with pairs of vertically placed loop-handles, beakers, and short-necked bottles. Simple undecorated rims and vertically notched rims are most common.

The most casual student may readily distinguish this pottery from Lake Michigan ware but plain sherds of the better quality may be at first confused with similar plain sherds of Aztalan pottery. Both are shell-tempered, smoothly surfaced, and of like texture, but rims, body shapes, and decorative motifs and treatments are distinctly different.

Later, three habitation sites on the Wisconsin banks of the Mississippi and three on the shores of Lake Winnebago supplied information for three variants which have been named, respectively, Grand River, Western Uplands, and Lake Winnebago.

Trempealeau culture.—The fourth distinct culture was first encountered in burial mounds and adjacent camp sites in Trempealeau County. The traits of the complex are distinct from those of the other cultures, although the pottery shows a pronounced similarity to that of the Lake Michigan culture. It is grit-tempered, has a granular texture, and not infrequently bears a primary surface decoration in intaglio effected by means of a cord-wrapped paddle, but the secondary decorative treatment is generally executed with a stamp or roulette, and the finer ware is smoothly surfaced, embellished in all known instances with an incised, cross-hatched outer rim, and radically departing in shape from the *olla*-form common to both the Lake Michigan and the utilitarian Trempealeau vessels.

Problems.—We have, then, four distinct cultures, of which close variants have been determined for the Lake Michigan and Upper Mississippi divisions. Our major problems are, briefly, who, when, and where. A general survey of historic Indian customs and a comparison of their culture traits with those known for the archaic groups convinces us only that we are dealing with the products of Indians; all the data cited indicates nothing more specific than a locally prehistoric time period for all four cultures; and available data regarding the geographical distribution, or center of distribution for each culture, are as yet meagre.

Two courses of research will contribute to their solution: (1) continued field research of stratified sites that may supply information bearing upon time sequences, and (2) laboratory research to determine the cultural grouping of pure basic traits to form characteristic culture-indicative complexes, followed by a comparison of local data with those available from neighboring fields.

The only stratified site investigated for Wisconsin gives evidence of an original Hopewell camp, probably contemporaneous with and later followed by Lake Michigan culture. The latter was finally contemporaneous with Upper Mississippi culture before disappearing to leave only Upper Mississippi culture. This time sequence applies only to the particular site studied and is not yet verified by findings at other sites.

A comparison of Lake Michigan and other pottery of the Woodland area makes it apparent that Lake Michigan ware, which is ascribed to some of the local Algonkins, is closely similar to so-called Algonkin pottery which occurs over an area that extends from Iowa to the Atlantic coast. A closely parallel complex of pottery traits is known for some of the proto-historic and historic eastern Algonkins. The distribution of the ware, in so far as we know it, corresponds to the distribution of historic pottery-making Algonkins. These suggestive facts do not warrant the postulation that only Algonkins possessed this pottery industry, but tend to support conclusions that it was a culture-trait of some of the Wisconsin Algonkins. The question as to whether or not the builders of the effigy mounds, with their Lake Michigan type of pottery, were related to Algonkian progenitors can not be determined on the basis of pottery alone.

A comparison of the basic Upper Mississippi culture complex with culture-indicative data from other fields yields the information that closely parallel traits are recognized in Illinois[1], Iowa[2], Minnesota, North Dakota, South Dakota, and Nebraska[3].

The Aztalan culture finds its near parallel in the earlier of the two variants[4] represented in the Cahokia culture of Illinois. More distant comparisons serve to identify the Upper Mississippi and the Cahokia-Aztalan basic cultures as of Southeastern character and probably origin. There is reason to believe that both cultures are relatively late intrusions into the Woodland area.

The Trempealeau complex of traits is found to be extraordinarily like that of the Hopewell culture of Ohio. One of the most important of these trait similarities was that of pottery. Research in other states has revealed that the basic Hopewell culture was influential over an area extending from New York to Wisconsin and from Kentucky to Michigan. The place of the culture in the time sequence has been determined as relatively early for one Wisconsin site, as previously stated, and the tentative chronology for Illinois in Krogman's[5] report also places basic Hopewell as relatively early in that state. However, accepting these chronological conclusions, it does not follow that basic Hopewell culture is to be identified with a definite time stratum wherever encountered; cultural relationship may involve cultural ancestors or cultural decendants as well as a single cultural generation.

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[1] Langford, George, The Fisher Mound Group. Amer. Anthrop., N. S., v. 29, No. 3, pp. 153-205, 1927.

[2] Keyes, Charles R., Prehistoric Man in Iowa. The Palimpsest, v. 8, No. 6, pp. 222-4, 1927.

[3] Strong, Duncan, and Bell, Earl, personal communication.

[4] Kelly, A. R., personal communication.

[5] Krogman, W. M., in paper presented before Amer. Anthrop. Assoc., Central Section, Milwaukee, 1930.

NOTES ON THE ARCHAEOLOGY OF JO DAVIESS COUNTY

BY

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ABSTRACT

Jo Daviess County, the most northwesterly in Illinois, lies chiefly in the Driftless Area but to some extent in the glaciated region. The more rugged part of the county is within the driftless area and scarcely a square mile has relief under 100 feet and may exceed 650 feet. The valleys of the present and former streams of the region exhibit a dendritic or leaf-like arrangement with reference to the master-stream, the Mississippi.

The vestiges of the aboriginal occupation of the county have sporadically received the attention of recognized institutions since about 1869. The great number of the mounds and their frequent concentration in fair-sized groups on prominent topographic features resulted in their being investigated early and often by amateur archaeologists—a circumstance which was not always conducive to the best use of these remains in an effort to reconstruct prehistory.

The University of Chicago maintained survey and excavating parties in the county during the summers of 1926 and 1927. The data from these expeditions as well as from previous surveys disclosed the existence of 152 linear, 434 conical, and six effigy mounds—a total of 592. A large earthen circle and an elliptical earthern ring are also known. It is expected that future discoveries will increase the total. The mounds lie principally within the unglaciated portion of the county and along existing or former stream courses. Several habitation sites have been found, chiefly adjacent to or near mounds.

Thirty-one conical, ten linear, and two effigy mounds of record have been excavated. Structurally the conical mounds differed considerably from the linear mounds. The conical, aside from the practically characterless small ones in three of the groups in which excavations were conducted, fairly uniformly presented an excavated area (involving either simple removal of top soil or actual intaglio), clay-ash stratification, fluent, i. e., puddled clay, and ash-beds. In the large conical mounds a vault (of log or stone or in combination), a buried trench, and burnt earth may be expected. The linear mounds with fair constancy revealed an excavated area, an ash-bed, and a mortuary hollow (an intentional depression for human remains and accompanying funerary objects). The two effigy mounds apparently had in common an excavated area and an ash bed. Aside from the foregoing, recorded structural details are scant.

Burials were present in 19 of the conical and 9 of the linear mounds. Multiple burials prevailed in the conical and the reverse in the linear mounds. Cremated and extended burials occurred only in conical and flexed burials only in linear mounds. Fragmentary and bundle burials were not peculiar to either. Burials beneath the floor or throughout the mound, entirely apart from fire- or ash-beds, were peculiar to conical mounds. Linear mounds were almost unique in having burials in the body of the mound associated with ash- or fire-beds.

Simple stone slab-burials without a mound superstructure are known, but are few in number.

The physical type represented by the skeletal remains is as yet unknown despite the fact that more than 60 skeletons have been discovered. The principal reasons for this are: (1) the earlier investigators were interested primarily in "relics" and, accordingly, noted little else than number, position, and size of the skeletons which were uncovered; (2) the very poor state of preservation of many of the remains.

Thus far we have little information regarding cultural succession. The available records for mounds excavated contain no mention of stratigraphic succession. Very little has been done toward excavating habitation sites and that little has yielded no information concerning temporal sequences. The paucity of cultural remains obtained by the University in its excavations and the wide scattering or total loss of most of the material objects retrieved by earlier workers, together with the simplicity of that which is known, enhance the difficulty of determining the identity of cultures and their temporal relations.

It is possible, however, to list from information contained in the literature, from the University survey of collections and sites, and from the results of excavation certain cultures which were or appear to have been in this county. Starting with the known, then proceeding to the earlier and less apparent they are: (1) a late historic Woodland culture (as exemplified by the Sac and Fox); (2) the Effigy Mound culture which Dr. McKern in Wisconsin has linked with the Lake Michigan pottery as being variants of the eastern Algonkian culture (possibly should be regarded as a Lake Michigan aspect of the Late Prehistoric phase of the Woodland basic culture[1]); (3) some components of the Middle Mississippi phase of the Mississippi basic culture that have affiliates at Aztalan in Wisconsin, Cahokia (East St. Louis), and Fulton County in Illinois; (4) components of the Great Lakes[2] phase (sometimes referred to as Illinois variant of the Hopewell culture) of the Woodland basic culture.

ARCHAEOLOGY OF THE ROCK RIVER VALLEY

BY

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The Rock River area surveyed by the University of Chicago in 1927-28 consists of Winnebago, Stephenson, and Ogle counties and includes principally the shores of Rock River and its affluents, the Pecatonica, Leaf River, Kyte and Pine creeks, Stillman Run, and two branches of the Pecatonica, Silver and Richland creeks.

In Ogle County there were more than a hundred mounds, the majority of which were small conical and the minority linear mounds, distributed in some thirteen groups, mostly within sight of each other along the west banks of Rock River. Most of the mounds were on fairly high ground and seemed to follow the topography of ridges. The mounds were of medium size, the longest linear one being 330 feet long, 26 feet wide, and approximately 3 feet high. The largest conical mound stood 10 feet high and was 54 feet wide. Pitting, errosion, and cultivation make many of them almost unrecognizable.

[1] The terminology of culture classification employed here is that suggested by the Committee on State Archaeological Surveys, National Research Council, Circular Letter, April 4, 1933.

[2] Tentative term suggested by Dr. Thorne Deuel in unpublished Ms.

Mounds in Winnebago County occur principally along Rock River; some effigy mounds are found at Rockford. Some score of mounds found in Stephenson County resembled the Ogle County types in size, shape, and condition.

Some nine village sites were located in Ogle and three in Stephenson County. They have been under cultivation for so long and have been so thoroughly searched for relics that the value of further excavation is questionable. No official excavations are recorded in either county.

Data on artifacts for the upper Rock River Valley in Illinois are more extensive than records on earth-works. Reports on seven collections in Winnebago County show arrowpoints, bunts, drills, spears, scrapers, stone axes, celts, pipes, s. s. gorgets, discoids, rubbing stones, mortars and pestles, bone tools, grooved plummets, pendants, slate and stone gorgets, red and green soapstone pipes, pottery pipes, paint plaques, triangular points, a frog effigy, a pebble carved into a human face, grooved hammers, copper implements of various kinds (chiefly knives), points, spears, axes, and pottery—mostly grit- and shell-tempered (a few sand-tempered) with decoration plain, striated, textile, incised, antler point, cord, punctuate, stamped, "roulette" and finger trailed.

A survey of some sixty collections in Stephenson County shows a similar collocation of artifacts but with less variety. Flints had been retouched by bevelling of larger and serration of smaller specimens. Celts and axes were of the heavier ferro-magnesian minerals. There were some peculiar copper awls, galena turtle effigies, butterfly bannerstones, hematite pieces, catlinite beads, stone awls, pipes, gorgets, a chalcedony pendant, mortar and pestle, plummets, pipes, drills, and truncate barbs. Pottery was rare and that found was grit-tempered with a decoration consisting of rope paddle, cord, incised line, punctuate, and fillet molding.

Some twenty-seven collections in Ogle County yielded material not strikingly different. Serrated and bevelled flints are somewhat more common and truncate barbs are slightly less numerous than in Stephenson County, and bunts are characteristic. Drills are numerous and the ratio of ferro-magnesian axes and celts to flint implements is relatively larger than in Stephenson County. Copper pieces, which are few, include a bead. Difficulty was encountered in locating sites of artifact finds as collections were large and old. One fluted axe, an arrow straightener, net sinkers, gouges, an effigy steatite pipe, a catlinite pipe, butterfly banners, gorgets, paint-cups, hammerstones, picks, and some large flint hoes and spades were notable. The pottery was mostly grit-tempered and red and black in color. The pieces were generally bossed by punching The decoration consisted of straight lines, incised semi-circular, rope paddle, punctuate, incised angle, bark and cross-hatched types. One bone drill and eight quartzite arrow or spear points were found.

A statistical survey of types of arrow and spear points in Ogle County (classification based on a modification of Fowke's system) seemed to indicate a consistent preponderance of shapes for collections in closely adjoining areas. Moreover, the larger collections of the county showed consistent relative numbers of common types. In plotting the relative frequency of types, going from up-river to down-river collections, two types of gradation in frequency were noticed, (1) a simple rise and fall like a normal frequency curve, and (2) a specific decline. The results are vitiated by the inclusion in the tabulations of the large collections of doubtful etiology, so far as location is concerned.

The affiliations of the prehistoric cultures of the upper Rock River Valley in Illinois seem to lie mainly with the Algonkian-speaking peoples.

The earliest historical movements in this region show that the Illinois Indians were first displaced (1605) by the Kickapoo and Pottawatomie who came from east of Rock River, and later by the Sac and Fox (1765) who came down the west side of the river. A little later the Siouan Winnebago intruded into Winnebago County and the Pecatonica Valley at Freeport. This happened simultaneously with the entrance of the white man. Thus all of the known movements of population have been down Rock River from the eastern Wisconsin region. In fact, Wisconsin traits are apparent in fluted axes, gouges, truncate barbs, hematite spuds or paddles, and in the scattered effigy mounds at Rockford, Oregon, and Freeport.

Considering that most of the artifacts are found along the stream banks which were thickly wooded in contrast to the dry prairie interfluviatile areas, an Eastern Woodlands culture is indicated. Whether the cultural movement was up or down river is important in determining the pathways and the position of the nuclei of cultural activity in this region in prehistoric times.

The testimony of the artifacts, if considered by itself, is often deceptive. Southern influences from the Middle Mississippi or Cahokia region are doubtless apparent in the large flint hoes and spades of one Ogle County collection and in early reports on stone graves in Oregon and further down Rock River in Whiteside County.

Resemblances to the so-called Fort Ancient culture are seen in the numerous small triangular points, in the mixture of grit and shell tempering in the potsherds, and in a bell-shaped pestle of quartz found in Stephenson County.

Affinities with McKern's Lake Michigan culture of Wisconsin are seen in the embellishment of pottery by punching embossments from the inside out, by the punctuate, stamped rectangular indented impressions, incised lines, antler-point decoration, bark marked, cord marked decoration, and grit tempering. Similarly, gouges, truncate barbs, and a hematite spud or paddle seem indicative of Lake Michigan types.

The occurrence of shell tempering in pottery harks back, in some respects, to the Upper Mississippi culture. (One gray colored shell-tempered sherd found near Grand Detour in Ogle County which possesses trailed or incised chevron and straight parallel uncombined line decoration resembles pieces taken from the Fisher site near Channahan.) One chalcedony pendant appears to have originated in the Lake Superior region as none of this material is available in the Rock River region. Other Upper Mississippi or Siouan affinities seem indicated by a catlinite pipe.

Possible resemblances to Hopewell culture consist only of a copper bead, an effigy pipe of doubtful authenticity, crescentic form of pottery decoration, and perhaps some finely worked flint implements.

Resemblances to western New York Algonkian culture as reported by Skinner are noted in the polished ceremonial forms, slate gorgets often perforated, bannerstones of el and winged types, pendants, a long pestle from Stephenson County, two micmac pipes, grooved stone axes, adzes, and celts, scrapers which are plain chips or arrow points reworked and often showing the original notches on the stem bases and which resemble also the snub-nosed points of the Upper Mississippi culture.

As some sixty types of arrow and spear points, eight knife types, and ten scraper types occur, it seems fairly certain that more than one culture is indicated for this region. The cruder types of scrapers may be remnants of earlier cultures, as they appear as the most important types at greater distances from the river banks on the east and west borders of Ogle County. (This was also found true by Keyes in the Oneota culture of Iowa.) A

definite type of artifact industry seemed to dominate limited areas such as the Pine Creek Valley of Ogle County. If late horizons may be regarded as synonymous with (Wisconsin) influences from the north, the relatively greater predominance of certain types of flints in that direction may indicate an age subsequent to other localized types that seem to center in Ogle County at Oregon.

So far as our comparative notes go, resemblances in artifacts are noted to (1) lower Mississippi, (2) Ft. Ancient, (3) Lake Michigan, (4) Upper Mississippi, (5) Hopewell, and (6) western New York Algonkian cultures.

ARCHAEOLOGY OF THE CHICAGO AREA

BY

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In spite of the fact that the Chicago area was an important center for Indian trails and portages, our knowledge of the archaeology of the region is very meager. On the maps of Albert Scharf, which show the locations of the Indian trails and sites of the area for the early part of the century, are listed sixteen major Indian villages, fifteen minor villages, forty camps, and twelve mounds or mound groups. There are two private collections in the area which are worthy of note, the Haase collection and the Schupp collection.

The material in the Haase collection is reported to have come from a mound which was located within the present confines of the Forest Home Cemetery in Forest Park, Illinois. The mound was graded down about forty years ago and in the process many skeletons and artifacts were discovered; of this material a large number of the artifacts were saved but only two skulls were preserved. The material includes grooved axes, celts, club-heads, various flint implements, bone and shell beads, a few potsherds and a considerable number of post-European objects. The flint work is represented by notched, triangular, and stemmed arrowpoints and by drills and scrapers. The post-European material includes two iron axes, four iron knives, several copper and silver buckles, copper rings, copper bracelets, two cross pendants, small copper rings fastened in rows on cloth, and three copper kettles. The initials "P. H." are engraved upon one of the silver ornaments. The objects of wood are two short-handled dippers.

The Schupp collection is said to have come from the Bowmanville village site which is located along the southern edge of the Rose Hill Cemetery in the City of Chicago. Stone objects in the collection include celts, fully-grooved axes, three-quarter-grooved axes, club-heads, discoidal stones, banded slate gorgets and bird stones, and flint implements. The flint work consists of side-notched, stemmed, and triangular arrowpoints in about equal numbers, and drills and scrapers. There are a few grit-tempered and shell-tempered rim-sherds whose decorations consist of incised and stamped designs and small round perforations.

The Coghill Mound group which lies just southwest of the City of Chicago was investigated by the University of Chicago in 1927. Three mounds were excavated and yielded several undecorated grit-tempered potsherds, one arrowpoint, one celt, a few flint chips, fragments of charcoal, and three badly disintegrated skeletons.

The Huber Village site, located at Blue Island, was excavated in 1929 by the University of Chicago. The site consists of a deposit of black soil, ashes, and charcoal in which are scattered artifacts, flint chips, stones, and

numerous animal bones. The depth of the deposit varied greatly from place to place but was deepest at the fire-pits where it extended down three feet from the surface. Several burials found by workmen were destroyed before the archaeologists were called in; these were said to have been in an extended position and a celt was found with one of them as well as some fragments of pottery and a fragment of leather. Three more burials were found grouped close together and apparently in an extended position; with one of these burials a musical rasp of bone was found. Over fourteen hundred potsherds were found but no complete vessels. All of the sherds are shell-tempered except several which are grit-tempered. The ware is light buff to gray and is composed of fine clay and fragments of shell. The vessels represented by the sherds are bowls, vases, and olla-like containers. Most of the sherds indicate that the vessels had flaring rims; the rims are undecorated except on the superior surface which is usually marked by a series of indentations of various kinds. Some of the rim-sherds have loop handles which are either plain or decorated by vertical grooves. The bodies of the vessels are decorated with long incised lines which are slightly diagonal from the vertical and vary from fine to broad incised lines. A great variety of bone work is present in the Huber material but awls are most numerous; other bone artifacts are flat needles with an eye at one end, split beaver teeth, deer horn arrowpoints, beamers of the "draw-knife" type, small cylinders of deer horn, and cut fragments of bone. The so-called musical rasp found with one of the burials is made of an animal bone and is about twelve inches long, one inch wide, and a quarter of an inch thick; along one side is a series of twenty-three transverse grooves about one eighth of an inch in depth. The stone work includes arrowpoints, flint scrapers, flint knives, one grooved axe, one celt, one grooved club-head, one crude sandstone pipe, a variety of hammerstones, and several large mortars. Only one side-notched arrowpoint occurs; all the rest are small triangular points. Spoons made of Unio shell are present as well as several fragments of a marine shell. One object of copper about ten inches long and about one eighth of an inch in diameter was found.

In summary, there are apparently several different cultures represented in the Chicago area. That of the Huber site is very similar to the Middle-Level of the Fisher site near Joliet which has been classed with the Fort Ancient culture. The Bowmanville village site material on the one hand shows relationship to the Lake Michigan culture of Wisconsin and on the other resembles the Illinois variant of the Hopewell culture. Finally there remain the post-European culture of the Forest Home Mound, which as yet has not been correlated, and the culture represented by the Coghill Mound group which cannot be determined due to the lack of diagnostic material.

THE ARCHAEOLOGY OF WILL COUNTY

BY

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ABSTRACT

Will county, in northeastern Illinois, may be placed by reference to its county seat, Joliet. Our knowledge of the archaeology of Will county is confined largely to the western portion, where the Desplaines, DuPage, and Kankakee rivers unite to form the Illinois. In this limited area we find one of the most important group of archaeological sites in Illinois.

Our knowledge of this area is due almost entirely to the efforts of Mr. George Langford, supplemented by the work of the University of Chicago archaeological survey. This survey has revealed approximately thirty mounds and about twenty-five camp or village sites. Excavation of three sites has yielded results which are significant in determining a relative chronology for northern Illinois. This paper is concerned primarily with a brief analysis of these three sites in terms of their interrelations with one another, both cultural and chronological, plus some indication of their cultural affiliations.

At the Kankakee River refuse site, located on the north bank of Kankakee River a short distance above its junction with the Desplaines, Mr. Langford found surface indications of three "cultures" which were distinguishable in regard to content and geographical distribution: (1) A "culture" characterized by large notched or stemmed projectile points and grit-tempered pottery; not localized on this site but widespread in region. (2) A "culture" characterized by small triangular projectile points accompanied by both shell- and grit-tempered potsherds, the latter predominating; sharply localized on this site. (3) A "culture" represented by a small mound containing disintegrated burials associated with shell-tempered pottery having a characteristic "trailed" decoration. The significance of this site did not become clear until the investigation of the Fisher site by Mr. Langford.

The Fisher site[2], on the south bank of Desplaines River about a mile above the Illinois, consists of two large mounds and several smaller ones, surrounded by about fifty "saucer-like" depressions containing fire-hearths, camp refuse, and storage pits. About six hundred skeletons have been removed from this site. The significance of the site, however, does not lie in its size but in the information which it furnishes in regard to culture-complexes and chronology. While several important problems are as yet unsolved, it is clear that there are three levels of occupancy in the two larger mounds as indicated by mound stratification, physical type, mode of burial, and associated artifacts. These three levels may be summarized as follows:

(1) The *lower level* contained dolicocephalic flexed burials occurring deep in the underlying glacial gravel and accompanied by practically no artifacts. These burials seem to represent a rather ancient period since all signs of intrusion have disappeared.

[1] G. Langford: "The Kankakee River Refuse Heap", *Amer. Anth.*, N. S., V. 21, 1919, pp. 287-91.

[2] G. Langford: "The Fisher Mound Group, *Amer. Anth.*, N. S. V. 29, 1927, pp. 153-206.

TABLE 1.—*Sequence of Cultures in the Desplaines Kankakee Region.*

Sequence of Cultures	Fisher	Kankakee	Adler	Other Sites in Will County	Tentative Affiliations
1	*Lower Level*				"Black Sand" Men (?) (Fulton Co.)
2			Adler Primary	Long Run campsite Bird Bridge campsite "Fire Hearths" campsite (Based on pottery)	"Hopewell"— "Adena"—(Ill.— Wis.—Iowa—Ohio)
3	Zone I *Middle Level*	Mound	Intrusive burials		"Grand River" (McKern)
	Zone II	"Restricted" Area		Oakwood Mound	"Fort Ancient" "Upper Mississippi" Utica Blue Island (Huber Site)
4	Zone I (Pre-European) *Upper Level*	"Extended" area		Most campsites in region	
	Zone II (Post-European)		Intrusive burial		Historic tribes

(2) The *middle level* is represented by two zones which are associated with the mounds proper. The lower zone is characterized by brachycephalic, extended burials accompanied by shell-tempered pottery having a characteristic "trailed" decoration. This pottery is also found in the surrounding pits associated with antler harpoon heads, worked antler tips, and a few crude flints. The upper zone contained extended brachycephalic skelletons associated with grit-tempered pottery with a barklike decoration, a rich bone culture, stone celts, triangular projectile points, and a few copper celts, beads, and flat ear-disks.

(3) The *upper level* contained brachycephalic burials partially flexed on their sides, stemmed or notched projectile points, long stone celts, undecorated grit-tempered pottery, and a few small shell-tempered pots with knobbed shoulders. One or two child burials in this level contained post-European artifacts.

On the basis of cultural similarity, the materials found in the smaller mounds and depressions (house-pits) may be allocated to the above levels. Likewise it is possible to correlate the material found at the Kankakee River refuse site with these levels, the first mentioned "culture" belonging to Fisher's upper level and the second and third "cultures" with the upper and lower zones, respectively, of the middle level at Fisher's.

The Adler site[3] consists of a group of eight low mounds extending along the right bank of Desplaines River a short distance below Joliet. In these mounds were found rectangular burial pits containing extended burials and secondary bundle-burials with a wide range of head forms. The associated artifacts consisted of a "Hopewell" type of pottery, a platform pipe of Ohio pipestone, pointed bone awls, a bone covered with sheet mica, a turtle carapace, a few bone tubes, and some notched projectile points. A few burials showed signs of red ochre. Intrusive into one mound, over the central chamber, were three extended burials associated with a shell-tempered pot. Intrusive into another mound was an extended burial with a brass buckle of European manufacture.

The primary Adler "culture", which shows certain affinities with Hopewell and Adena, is not represented at the Fisher site but the intrusive burials may be duplicated in the middle and upper levels, respectively. From a cultural standpoint there is at present no basis for placing the Adler "culture" in reference to the lower level at Fisher's. On the basis of physical type and mode of burial, however, it is likely that the Fisher lower level burials are the older.

On the basis of these sites it is possible to offer a relative chronology for the "cultures" of this region which attaches to the historic period and extends to a rather early period (Table 1). It is important that this outline should be filled in and its wider affiliations determined. Certain of these wider affiliations are suggested on the accompanying chart.

Although this report has merely summarized the available material, much of which is still in manuscript, it has perhaps shown the importance of stratified sites in correlating cultures chronologically. It is fortunate for Illinois archaeology that these sites have been excavated so as to yield this information.

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[3] Based on unpublished material on the excavation of the Adler mounds by G. Langford and the University of Chicago Archaeological Survey.

CULTURAL SEQUENCE IN FULTON COUNTY

BY

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ABSTRACT

Two seasons (1930 and 1931) of archaeological exploration by the Department of Anthropology, University of Chicago, of aboriginal sites in Fulton County, Illinois, has resulted in the delineation of a number of components (unit of culture found at a *pure* site) belonging to one or the other of two *basic cultures*, the Woodland and the Mississippi.

"Cultural stratification" or superposition of these components indicated in several cases a relative chronology.

One of the "stratified" sites, a mound (F°77) near Liverpool on the Illinois River proved to have Hopewell-like traits and artifacts. It was built on an older cemetery in the "black sand"[1] containing burials and a few artifacts. Both cultures are Woodland but the physical type and culture of the cemetery seem more ancient than those of the group building the mound. Here, then, we have the Hopewell-like phase overlying and later than that of the Black Sand component.

A village site (Fv49) on the Chester Whitnah farms yielded evidence of cultural superposition. A Hopewell-like component, much like that found at Liverpool, was found beneath shell-tempered sherds, and artifacts similar to those found in the Dickson site (Fc34) near Lewistown and considered to belong to the Middle Mississipppi phase. This site indicated the priority of the Hopewell-like phase to the Middle Mississippi.

A third site, a mound (F°14) on the Joy Morton estates, gave evidence that at different times three cultural groups had used a prominent point of a ridge as a cemetery. The earliest occupation was called the F°11 component because a nearby site, in which numerous flexed burials in red ochre were found, together with caches of implements and ornaments, gave a fuller definition of characteristic traits. Above the burials of the F°11 component lay other flexed skeletons, probably much later in time, that were seldom accompanied by cultural objects and were known as the F°7 component from another mound of the same chain where only this simple complex of traits occurs. The latest burials in the tumulus, of the same culture and physical type as those found in the Dickson site (Fc34), were inhumed at various depths, occasionally disturbing burials of the two earlier types. The sequence derived from F°14 is: earliest, the F°11 component (Red Ochre Phase of Woodland), next the F°7 component (Woodland), and latest the F°14 component of Middle Mississippi.

The Fouts village site (Fv664) contained fifteen or more house pits which yielded the remains of rectangular houses, shell-tempered sherds, and artifacts belonging to the Middle Mississippi (probably identical with the Dickson component).

Near Maples Mills on the Robert Gooden farm occurs the Gooden component (Woodland), characterized by thin grit-tempered pottery with corded or stroke-decorated designs and raised rims, and flexed burials occasionally accompanied with a pot or a small number of projectile points.

[1] Yellowish sand containing a considerable amount of organic material.

To summarize: No stratigraphic evidence was encountered in the case of the Gooden component but it appears to be more recent than most of the others mentioned, on account of the excellent state of preservation of the bones and indications from more distant sites of a similar nature. The Black Sand component was found in association with the Hopewell-like phase only, but seems to be one of the oldest found, judging by physical type and evidence from other sites in Illinois and elsewhere. Based on stratigraphy and other evidence, the relative sequence of cultural elements in Fulton County seems to be, putting the oldest lowest in the table:

Component	*Basic Culture*
Gooden	Woodland
Dickson (Middle Phase)	Mississippi
F°7	Woodland
Hopewell-like	Woodland
F°11 (Red Ochre Phase)	Woodland
Black Sand	Woodland

ARCHAEOLOGICAL REMAINS IN ADAMS COUNTY, ILLINOIS

BY

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ABSTRACT

This discussion of Adams county is limited almost entirely to the investigations conducted by the Department of Anthropology of the University of Chicago during the summers of 1928 and 1929. The University's survey of the county included the mapping of aboriginal sites, a study of the collections made by local amateurs, and excavations of three mounds.

The survey revealed about 300 mounds, the most common type being the conical or dome shaped, although rectangular pyramidal, and flat-topped conical types are also represented. At Indian Mound Park, three mounds had been constructed on a terrace or platform. Generally the mounds occur in groups on or near the edge of bluffs overlooking the river, floodplain or stream bed, or on high ground between creeks. The group of seven dome-shaped mounds, mentioned by Thomas as "Indian Grave Prairie", is located in the American Bottoms in close proximity to a particularly valuable village site. The type of pottery from this village site seems to be Illinois variant of Hopewell.

The local collections include material belonging to several cultures. Three-quarter grooved axes, discoidal stones, leaf-shaped blades, stemmed, notched, and triangular points, celts, bell-shaped and cylindrical pestles, stone spheroides, and plummet stones are all common. Hematite celts, stone pendants, catlinite pipes, stone adzes, elbow pipes and bone beads are less common. Not enough excavation has been done to allow these cultures to be accurately separated and identified.

The three mounds excavated were the Lemmon mound, located 16 miles north of Quincy; the Dick mound on the south side of Quincy; and the Parker Heights mound on the north side of Quincy.

The Lemmon mound yielded twenty-two burials, the majority of which were flexed. Twelve burials were associated with stone slabs. The artifacts found were a flint scraper, a flint ball or core, and a number of broken

pots. These pottery vessels resemble in their grit tempering, shape, and decoration those found at the Dick mound, described below, and those vessels found at the Tampico mound in Fulton County. They also bear a distinct resemblance to those described by Fowke as occurring in southeastern and central Missouri. The burials in the Dick mound were also flexed and in some cases associated with stone slabs. Most of the pottery found in this mound was associated with the burials.

The Parker Heights mound, the largest of a group of thirteen, was constructed from the loess deposits which overlay the limestone rock of the eastern Mississippi bluffs. The mound was 80 feet in diameter and 11 feet high. The skeletal material which was uncovered varied greatly in the state of preservation, which was apparently unrelated to position in the mound or to the age of the individual. In all, 69 skeletons were uncovered. Of those whose age and sex could be identified, six were infants, 16 were children, and 36 were adults; there were 10 males and 4 females. It was not possible to determine the position in all of the burials but in those so identified practically all were flexed. The orientation of the bodies was not uniform but varied throughout the mound. The position of the body had no correlation with age, sex, or height above the floor. Only one body had been buried below the original ground surface. Sixteen of the burials were less than one foot above the floor, four were one to two feet, eight were from two to three feet, twelve from three to four feet and twelve from four to five feet. There were no burials higher than six feet above the floor. All of them were inclusive in the mound.

Limestone slabs were found associated with one-third of the burials. There were a few definite sepulchres, some burials had slabs laid over the top to form a series of arches, while others presented a hit-and-miss arrangement of the stones. There was no connection between the use of stone with the presence of artifacts, or with the sex, age, position of the body, or height above the floor.

One of the most interesting features of the mound was the great central fireplace which was first noticed at the 30-foot line and extended 20 feet east and west and 15 feet north and south. The fired area was 17 to 21 inches thick. Limestone slabs had been placed on the original ground surface and covered with a layer of earth. This was then lined with slabs and an enormous fire built in the center. The various soils used in the construction of the fireplace and to smother the fire resulted in various colors appearing in the baked earth. There were no evidences of cremation. The burials had been grouped around the fireplace and none were found in the earth immediately over it.

Artifacts in the mound were few. The few sherds consisted, except in one case, of shell-tempered material. Other artifacts were eight small notched arrow-points, two larger projectile points and one flint knife, two small pierced shell beads and a shell necklace of nine pieces, and two elbow pipes with round bowls, one having two thin incised lines around the top of the bowl. There were few animal remains in the mound but two dog skeletons were found not associated with human burials.

It is difficult to say at present what the eventual cultural connections will prove to be, but there seems to be sufficient indications in the type of pottery, type of burials, and the physical type to link these excavated mounds in Adams County with the finds made in Missouri by Fowke and with one of the cultures identified by Webb in Kentucky which he also believes to be related to Fowkes' Missouri culture.

MOUND EXCAVATION IN JERSEY COUNTY THE ISRINGHAUSEN MOUND GROUP, ROSEDALE TOWNSHIP

BY

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In February, 1931, Mr. John Isringhausen found two very fine, white stone grooved plumb bobs on a ridge on his farm one mile east of Nutwood, Illinois. A survey showed the ridge to be "Y" shaped, the branches lying almost due north and south and the stem northeast. Three mounds had been exposed on the south end of the west branch of the ridge. The long axis of mound number one lies east and west. Immediately behind it are numbers two and three, the long axes of which lie northeast to southwest.

On the east branch of the ridge are nine mounds. Number four, whose long axis is northeast-southwest, is considerably larger but lower than the others, due probably to its having been under cultivation for a long time. The long axes of the other eight mounds lie north and south.

Mound number one is 67½ feet long, 30 feet wide, and 4 feet high. Mound number twelve is about the same size, and the others except number four are smaller. They are approximately 35-50 feet long, 20-25 feet wide, and 4-6 feet high.

An old camp site occurs between the branches of the ridge and at the base of the west ridge where there is a fairly large spring. Numerous arrow heads, several axes, a flint pick, and two discoidals are known to have come from this area.

The ridges are composed of a clayey and sandy soil which facilitates very good drainage. The mounds are made of the same type of soil and number one shows no lens formations, the base being quite difficult to locate.

Mound number one was chosen as the site of excavation. A total of eight and a half working days has been spent and the mound is now about five-eighths completed.

Twenty-one skeletons have been located, exposed, and photographed. In two small areas disturbed by former excavations, there have been at least twelve skeletons as indicated by the skull count. In the north side of the east end of the mound were three baby skeletons in such a poor state of preservation that only their location could be noted. Only one compound burial, consisting of two skeletons, has been found. Most of the burials have been at or near the base but four have been found a foot or less below the top of the mound.

Of the twenty-one skeletons, fourteen were definitely flexed, four were incomplete but were no doubt of the flexed type, and three were extended. In all but one of the fourteen flexed burials, there was a marked flexion of the legs upon the thighs and in three there was also a marked flexion of the thighs upon the abdomen. The positions of the arms were more varied, the most extreme flexion being with one hand lying over the corresponding shoulder giving the impression that the hand was grasping the clavicle (found in three). Most commonly one arm lay along the side or was partially flexed with the hand over the pelvis or abdomen and the other arm was flexed to such an extent that the hand was on the opposite side of the body or up near the opposite shoulder or in the region of the mandible.

All but two of the burials were on the back; one was on the right side and the other on the abdomen favoring the left side. Two of the extended burials had the arms along the sides with the hands at the sides of the pelvis and the other had the hands over the pelvis.

Two of the burials had apparently been disturbed by later burials. The pelvis and lower limbs of number four were found scattered in the soil immediately above number three. The right ribs and arm of burial number nine, a child of ten or eleven years, had been piled at the right side of the head, the space created being occupied by the lower limbs of number ten, a child of about eighteen months.

Two burials had extra bones interred with them. Burial number seven had several leg bones and an innominate over the flexed lower limbs and several fragmentary arm bones over the chest. The compound burial had an extra skull between and below the two skulls of the burial and several leg bones, a humerus, and a scapula over the flexed lower limbs. There were also two tibiae and a fibula at the top of the skull of number seventeen.

Burial number five showed evidences of bone disease and fractures. There was an extensive periostitis of both tibiae and fibulae with some anterior bowing of the left tibia. The etiology of the condition has not been determined. There was a healed oblique fracture through the deltoid insertion of the left humerus in which the position was exceptionally good, and there was an old transverse fracture through the middle of the left clavicle in which union was complete with some increase in the curve of the bone.

Not many artifacts have been discovered. With burial number three were 250 shell beads (one of the Gulf Coast snails?) in four loops around the neck. Burial number ten had five shell disc beads at the front of the neck and burial number sixteen had six small disc beads under the mandible. The two white plumb bobs were found on the surface at the southeast end of the mound, and just before this area was excavated a large, unfinished, granite plumb bob and a circular shell pendent were also picked up on the surface. During the excavation of the disturbed area in this end of the mound, a finished grooved hematite plumb bob, an unfinished hematite plumb bob, and a broken arrowhead were found but they were not associated with any of the burials. The point of a bone awl was found with burial number twelve.

In the extreme west end of the mound, two badly broken pots of cord-imprinted ware with rather pointed bases were found in the sod. The larger pot is seven and a half inches high, of moderate thickness and grit-tempered. The smaller pot which is five inches high and quite thick, contains a very small amount of grit tempering and several large pieces of rock, one of which shows on both the outer and inner surfaces. These pots were found approximately five feet apart and were not associated with any burial. Between them in the sod were scattered a large number of charred bones. No other pottery, not even a sherd, has been found.

Fifty-two feet east of the west end of the mound and north of and at right angles to the long axis, a soil profile was made. Near the long axis the soil was darker in color and less compact, indicating disturbance. Numerous bones were scattered all through it. Just outside of the disturbed area burial number nineteen was found, and still further out burials numbers twenty and twenty-one.

The work in this group has not progressed sufficiently to warrant the drawing of any conclusions. It is hoped that the excavation of this mound and one on the east ridge can be completed within the next year, when it may be possible to make some comparisons.

SOME PROBLEMS OF RECENT CAHOKIA ARCHAEOLOGY

BY

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During January and February of 1930 and the summer season of 1931, field parties of the University of Illinois carried out archaeological excavations on the site of the Powell mound in the Cahokia area, located on the truck farm of William and Frederick Powell, on Route 11, Fairmount, a suburb of East St. Louis. In 1930, Mr. Thorn Deuel of Chicago and Dr. W. C. McKern of Wisconsin co-operated in studying the large Powell mound; in 1931, a smaller mound about 25-30 yards south of the large Powell mound was carefully excavated with Mr. Gene M. Stirling in charge of local explorations.

The investigation of both mounds revealed important data and the interpretation of the results of our investigations show that the evidence of the two mounds dovetails and, taken as a whole, gives us our first stratigraphic or chronological evidence in Cahokia, and helps to some extent to fit the so-called Cahokia complex of cultures into the prehistoric sequence tentatively established in Fulton County, Illinois.

Notes and photographs taken on the profile through the long axis of the large Powell mound by Dr. L. E. Workman of the State Geological Survey during the course of mound removal by steam shovel in 1930, indicate that the mound was constructed in two stages, and consisted of a top layer of mound earth about 18-20 feet in height, brought to an apex in a hogback ridge running along the greater axis of the mound, and an underlying original mound core which was approximately 27 feet high. The older mound was of the rectangular, flat-topped variety familiar in the Cahokia area. No burials or burial furniture were found in the basal mound structure, and the potsherds and artifacts contained therein were evidently chance inclusions made while the mound-builders were obtaining the baskets of mound-earth from adjacent camp and village sites.

Later a second mound was built over the original flat-topped structure, but first the mound builders made two unique burial plots on the surface of the basal mound. The first of these burial plots was destroyed by steam shovel; the second was hand trowelled by a member of the University staff and adequate notes were taken. The long bones and skulls of several secondary interments had been placed between alternating sheaths of cedar bark with a blanket of shells covering the bones. A thin corn husk or grass matting had covered the whole burial plot, approximately 18-20 feet in diameter. Two wooden spools covered with sheet copper, interpreted as ear pendants, fell from the burial level during excavation. The spools and the small marine shells have definite associations with Florida and the southeastern Atlantic region.

Other burials found on the slopes of the mound were without burial furniture. No material of cultural significance was found in the upper 20 feet of the Powell mound.

Excavations made in February, 1931, provided information as to the structure of the seven feet of mound material left at the base of the large mound destroyed by steam shovel. Beneath the mound were extensive

village site remains, potsherds, stone and bone artifacts, and kitchen refuse. The pottery in the underlying camp-site was of the same or related type as that accidentally included in the earth used in mound construction.

The excavation of the second and smaller mound on the Powell farm yielded data pertinent to the explanation of features in the large mound. Below the second Powell mound, were found evidences of a second village site culture entirely different from that found under the large Powell mound. The outstanding feature of the village site under the second mound was an extensive system of pit structures, 30 to 40 feet in diameter, varying in depth from 4 to 9 feet, and extending at least 100 feet from north to south. Our reconstruction of the site from transit readings shows an area some 40 by 50 feet (the east-west diameter will be shown to be longer on further excavation) surrounded on the north, east, and south by a continuous pit structure. There is a definite suggestion here of large subterranean house structures surrounding three sides of a central court. Present data do not inform us as to how far the court extends to the west or whether it is enclosed by pit structures on that side.

The bottom portions of these subterranean pits had been filled by storm water or river silting, with the occurrence of ash and charcoal at different levels in the pits, as well as charred floor matting, to indicate occupation at different levels or floors. Finally, after the abandonment of the village site and complete filling of the pits by sand and refuse or wind-blown materials, the mound, rectangular in shape, and probably relatively low and flat-topped in structure, had been constructed after careful preparation and smoothing of the ground which had accumulated over the old village site.

Burials were found only outside the mound, either just at feather edge or on the slopes after soil creep from the mound had started. Pottery and artifacts found with the burials are different and belong to a later culture than those found in the bottoms of the pit structures. The pits occur under the mound, running out to the west and north. They do not extend very far to the north, however, for the field party in 1930 found under the large mound pottery characteristic of the village site outside the pit-structures. Moreover, they found no evidence of the presence of such large pits under the large mound. For a square mile or more in the Fairmount region to the south of the Collinsville Bluffs and extending to the west into the built-over sections of East St. Louis, along both banks of the former course of Cahokia Creek, is found a huge village site. To this extensive surface culture is attributed the pottery and flint industry found associated with burials outside of and definitely more recent than the sub-mound village site culture on the Powell site. We have called the culture of the pit structures the "pure village site" culture, because the mound built over the village site has served to mantle and isolate the early village from interpolation of pottery and artifacts belonging to succeeding cultural developments.

The culture found outside the mound is more recent though definitely prehistoric, and is distinguished by several traits of material culture not found in the "pure village site" culture of the large pit structures. Outstanding is the occurrence with the burials, made intrusive into the top of the pits outside the second Powell mound, of a soft-textured, gray and black shell-tempered ware, often modelled on the rim in the form of animal heads, the head and tail of the duck being highly conventionalized and stylized in a characteristic manner. Also, there has been found with intrusive burials around the second Powell mound, at McCary's farm a quarter of a mile east of Powell's, and underneath the first Powell mound, but never in the pit structures, another characteristic pottery form—a flat-bottomed beaker pot

with conventionalized spout on the rim and a small pottery plug inserted in the side near the top of the beaker as a handle. This pot has been dubbed the "bean pot" by members of the field party. It has a wide distribution all over the surrounding area. Formerly, the pots themselves had not been found, but many of the pot handles had broken out entire and had aroused considerable speculation among collectors when picked up at many places on the village site south of the Collinsville Bluffs.

Both the "bean pot" and the duck-effigy bowls occur in the burial furniture in the famous Don Dixon mound at Lewiston. They have been found likewise in a mound explored by Charles Harris in Schuyler County, a location between Cahokia and Lewistown. Other features of pottery design and manufacture, hitherto regarded as "Cahokia" are distributed in the same way.

Historically, we must continue to call the whole Mississippi Bottoms in the region of St. Louis the Cahokia region. But recent investigations imply that we should hesitate to denominate a particular culture in the area as "Cahokia culture." The pottery of the "pure village site" at Powell's has a markedly higher percentage of superior ware, from the point of view of manufacture and design. As far away as the site of the Aztalan terraced mounds, a Wisconsin counterpart of Monk's Mound in the Cahokia region, Dr. W. C. McKern and Dr. S. A. Barrett find numerous parallels to both the "pure village site" culture and the "Bean pot-effigy bowl" culture, morphological pottery traits of both cultures occurring in about equal strength according to a recent analysis by Dr. W. C. McKern. As between Lewiston and Cahokia, a common conclusion has been reached in regard to the chronological position of the "Bean pot-duck effigy" culture; it is tentatively regarded in both places as the most recent cultural phase.

SOUTHERN ILLINOIS AS A FOCUS FOR PRIMITIVE PEOPLE BECAUSE OF GEOGRAPHIC FACTORS

BY

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It is a well known fact of history that a country under primitive conditions may be traversed most easily by following its water courses. The concentration of streams upon the borders of southern Illinois is extraordinary. If the Indians used these waters, southern Illinois must have corresponded to a junction point of many railroads. The mighty Mississippi flows past southern Illinois on the west. On such a splendid route of communication, northern tribes could have descended the river and southern tribes ascended it. Along the eastern and southeastern boundaries of Illinois, flow the Ohio and its tributary, the Wabash, both large rivers and also excellent routes for the travel of the Indians. Where the Ohio joins the Mississippi at Cairo, is found the chief point of water concentration of central United States. The mouths of the Cumberland and Tennessee are only a short distance away, and, though farther away, but still at the border of southern Illinois, is the Missouri bringing its tribute of water from another direction. Thus these streams coming from very distant regions could have brought into contact very distant tribes.

An unusual feature of the Cumberland is its great bend to the south. Rising in eastern Kentucky, close to the eastern border of the Cumberland plateau, its source is near the only break in the escarpment of the great

plateau highland, Cumberland Gap. From its beginning in eastern Kentucky, it swings far to the south into Tennessee, and then turns north to join the Ohio at the border of southern Illinois. The Tennessee is a longer and larger river; it has more distant sources and bends even farther south than does the Cumberland. Its sources are beyond the eastern border of the plateau region, in the Great Appalachian Valley and Ridge province, and even the Blue Ridge barrier beyond. Its great bend carries it into northern Alabama before it, too, turns north to enter the Ohio a few miles from the mouth of the Cumberland. Not only from near the sources of these two rivers could tribes have come to southern Illinois, but southern tribes from the territory touched by the great southern bends might also have been led hither.

The Ohio and its tributaries bring their water from a divide that swings in a vast arc from the mountains of North Carolina to northern Indiana. Among its southern branches, the Kentucky has its source near that of the Cumberland, not far from Cumberland Gap. The Great Kanawha and its tributary, the New, have a source near the eastern border of the Blue Ridge barrier, and provide a path from western North Carolina through this barrier, across the valleys and ridges of the great lowland between the Blue Ridge and the Allegheny plateau, and also across the roughest portion of the plateau to the Ohio. This route through the rugged mountain country of the plateau is scarcely a navigable one for the commerce of the white man, but it did provide a way for the Indian and his canoe. That this route was a favorable one is proved by the fact that the white man found it convenient to use its upper portion. Settlers that traveled southwest through the Great Valley turned eastward, ascended the New river to its source and then crossed the divide to reach the eastward flowing Yadkin or Catawha, which leads to good lands in western North Carolina. And settlers from these same lands in western North Carolina who were moved by the impulse to go west traveled the same route through the Blue Ridge to the Great Valley from which place a number of routes invited them.

The historic importance of the Ohio with the wide spread of the two streams which form it, the Allegheny and the Monongahela, as a highway for the white man across the barrier of the Allegheny plateau, is well known. It is reasonable to believe that the Indian found it as convenient to use. Northern tributaries of the Ohio, the Muskingum, the Scioto, the Miami, and the Wabash are reached from the Great Lakes region by easy portages which were used extensively by French explorers guided by Indians who were familiar with them.

From the north, the Mississippi and its tributaries, the Illinois and the Wisconsin, also furnished routes from the Great Lakes region toward southern Illinois, and the Missouri led from more distant regions. As the white man followed the last named river to reach the great western and northwestern plains, and even the distant Rocky mountains, it is reasonable to suppose that the Indians also followed it in their migrations.

The lower Mississippi borders the states of Arkansas, Tennessee, Kentucky, Mississippi and Louisiana, and restless tribes from these southern regions might have reached southern Illinois without much difficulty.

Thus the rivers that bring their waters to southern Illinois, invited the tribes not only along their courses and from their distant sources to travel to southern Illinois, but they beckoned across easy divides and thus exerted an influence over more distant regions. They set the stage for a mingling of Indian cultures. It is the task of the anthropologists to examine the evidence of the region to see whether this has happened or not.

The climate of southern Illinois is favorable for Indian life. The variations caused by the frequent passage of cyclones and anticyclones must have been stimulating to the Indian as they are to the white man. In winter, there were cold spells, but their duration is not long. The summers furnish a long growing season, from six to seven months, which gives ample time for the maturing of Indian corn. A rainfall of from 40 to 42 inches is favorable for corn and forest growth.

The topography is also favorable for Indian life. A long range of hill land from 15 to 20 miles wide extends across the state from east to west. South of this, is a lowland of about the same width and still farther south is a shorter and lower belt of hills which occupy the extreme southern end of the state. Between the hills of Illinois and the Ozarks of Missouri, the Mississippi flows in a flood-plain from 5 to 10 miles wide. This flood-plain, which is chiefly on the Illinois side, is a good site for Indian villages which could be located near the bluffs of the hill land and close to a creek or ox-bow lake of the flood-plain. Such an arrangement would permit the canoes being brought to the very edge of the village site. Small streams cutting down through the wall of the bluffs give easy access to the upland. The hills and uplands were good hunting grounds. Many deep valleys with cliff-like walls provided cave-like recesses, good for rock shelters. The crests of the hills near the village sites made good burial places and excellent lookout points, while the narrow, winding valleys were admirable places for defense in inter-tribal warfare. Throughout the hills of southern Illinois are many caverns that could have been used for shelter, storage, and burial places.

Originally a splendid forest, favorable for Indian life, covered southern Illinois. It could have been used for shelter, shelter material, and for fuel. Out of it could have come material for their weapons, their canoes, and their dug-outs. The forest was also an admirable hunting ground for there is evidence that it abounded in bears, wild turkeys, squirrels, deer, raccoons, buffaloes, and wild pigeons. The streams and lakes of the flood-plains gave them fish and wild geese and ducks. Even today, the Mississippi is a favorite route for the wild geese and ducks during their spring and fall migrations, and hunters still come from many miles around during the shooting season.

Southern Illinois has some minerals that were useful to the Indians. There are three places where admirable flint for stone weapons could be secured. A short distance southwest of Cobden there is a deposit of kaolin that would have been suitable for pottery. It has been worked rather extensively in recent years by the white man.

As a summary, it may be stated that the geographical environment of southern Illinois was favorable for Indian life. There were minerals that Indians were accustomed to use, a forest friendly to his manner of life, and a topography suited to his way of living. The climate was stimulating and the water highways were concentrated to an unusual degree upon the borders of the territory.

ALLEGED SIOUIAN SITES OF SOUTHERN ILLINOIS

BY

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ABSTRACT

In all of the early accounts of the settlement of Southern Illinois little mention of Siouian settlement is to be found. Consequently, many of the modern historians have assumed that the Sioux did not inhabit and influence the settlement of Illinois. In brief, this paper mentions some of the evidence of the Siouian occupancy. These evidences are traditional, historical, and archaeological. Local tradition indicates that some Siouian group occupied villages near DeSoto, Elkville, Horse Shoe Lake, and McClure. Some of the older inhabitants tell of the return of the Osage or Omaha Indians to what they term their former homes. Some of the early records indicate that Marquette visited an Omaha village somewhere near Clear Creek. Another source indicates a Jesuit missionary found a Quapaw village near Olmstead on the Ohio River.

In the forty-first annual report of the Bureau of American Ethnology, Mr. Myer traces a probable migration of the Siouian people through Tennessee and shows that a number of sites in Southern Illinois resemble very closely what he considers to be Siouian villages. His statements are strengthened by the close resemblance of his "Gordon people" to the Madisonville, Ohio, representatives of the Fort Ancient culture, which John R. Swanton has shown to be Siouian. From Thomas, Bushnell, and from Alvord's "Settlement History of Illinois", we learn that the Quapaw are known to have fortified their towns with earthworks and to have built mounds for various purposes, one type of mound peculiar to them has been found on the Ohio just east of the mouth of the Wabash and scattered through the southern part of Illinois are many graves and burial mounds similar to those used by the tribe in historic times. The peculiar feature of the mound architecture referred to seems to be the truncated, conical mound built in conjunction with a lower, more extensive, flat-topped mound, usually rectangular but frequently irregular and sometimes even pear-shaped or circular. At the Linn site, fifteen miles southwest of Anna in Union County, is found a fortified village enclosing several mounds including one of this description. A similar mound is found near Lake Milligan at the southernmost point of the state. At the Kincaid mounds, about twenty miles east of Metropolis, is a large village including several very large mounds, one of which has this same characteristic.

The main effort of this paper is to describe the Linn site and to show that many other remains in the form of earth-works, rock shelters, and rock-carvings may also be ascribed to the Siouian Indians, and to indicate that other sites may well be of Siouian origin. However, it is not the purpose of this article to claim that over half of the earlier remains may be definitely ascribed to the Sioux, as there is considerable evidence to show that the later Illinois Indians, the Shawnee, the Delaware, and the Cherokee, have all left evidences of their sojourns in this territory.

A PRELIMINARY SURVEY OF THE ARCHAEOLOGY OF THE WABASH VALLEY

BY
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In the summer of 1930, the University of Illinois, through the department of the Illinois Archaeological Explorations and with additional funds from the Smithsonian Institution, began a preliminary survey of the archaeological remains of the Illinois side of the Wabash valley. Dr. F. M. Vreeland of De Pauw University conducted the survey. He was assisted throughout the summer by F. M. Williams and for a short time by the writer.

The aim of the project was to make a rapid reconnaisance of the archaeological remains of the region with a view to future excavation and for a groundwork for a complete survey to be made later.

In thirteen counties the survey located 710 mounds, 71 camp or village sites and 39 collections. Many of the mounds had been demolished either by vandals or by cultivation of the fields in which they were located. Not accounted for in this total are 19 doubtful areas that were reputed to be mounds by local tradition, a few of which may be mounds but whose exteriors are so changed that only excavation will reveal what they are.

These thirteen counties were in two tiers, one fronting on Wabash River and the other the next line of counties to the west and through most of which flows Little Wabash River, a tributary of the Wabash. The larger portion of the mounds was found in the first tier of counties, usually on the ridge or line of hills which marks the boundary of the river flood-plain.

The Chenoweth group in Clark County, composed of sixty-two mounds, was the largest and most impressive. It is possible that the group was larger at one time, as the whole group is under cultivation. A small group of only ten mounds is located in the Dogtown hills near the town of Dogtown in White County, overlooking Wabash River half a mile away. Three of the group have been plowed over but are otherwise untouched. Two of the group are in a cemetery and have been opened in digging graves for recent burials. It is from these that we learn what we may expect to find in the others. Although no scientific observer was present, Dr. Sibley of Carmi obtained from one of the men who dug the grave some pipes and some sheets of mica with which the grave was lined. The other five mounds are in a wooded patch across the road and are untouched except for some small holes, dug by vandals, that damaged nothing more than the symmetry of the mound. One is seldom so fortunate as to see small mounds like these with their original contours.

Lawrence County is the location of a group of twenty-six mounds with a well-defined village site. All of the mounds are small and have either been plowed over considerably or have been tampered with by pothunters, who have left no record of what the mounds contained. Seven of the group are arranged in a horse-shoe formation on a bluff overlooking a stream.

Another noteworthy group of forty-four mounds and a village site was found on a ridge overlooking Embarrass River in Jasper County. The ridge is approximately a mile long and from a quarter to a third of a mile wide.

Conclusions as to the contents of the mounds cannot be made as the survey was solely exploratory, but there can be no question of the wealth of archaeological material in the region.

PAPERS IN BOTANY

Extract From the Report of the Section Chairman

All thirteen papers on the Botany Section program were presented in the section meeting, and twelve are published herein.

The following article was withdrawn from publication:

"Preliminary Pollen Statistics for Two Michigan Bogs," by Paul K. Houdek.

The average attendance at the meeting was fifty-eight; the maximum, sixty-seven.

Dr. H. S. Pepoon, Lake View High School, Chicago, was elected chairman for 1932-1933 and Dr. E. L. Stover of Charleston was named as alternate.

(Signed) Charles A. Shull, *Chairman.*

STRUCTURAL AND METABOLIC AFTER-EFFECTS OF SOAKING SEEDS OF PHASEOLUS*

BY

W. M. Bailey

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The purpose of this investigation was to determine the effects of soaking the seeds on the germination and on the number of mature plants produced, weight of plants and rate of growth, stem and leaf structure, percentage of water and dry matter in the plants, relative abundance of various carbohydrates and nitrogen compounds, rate of respiration and catalase activity.

Early Valentine beans *(Phaseolus vulgaris)* were used. The seeds, after being sterilized, were soaked in sterilized distilled water, with aeration except in the study of the effects of soaking on catalase activity. The periods of soaking varied from 8 hours to 9 days. The seeds were planted in the greenhouse. The plants were harvested when they had reached the blooming stage.

The result are shown in the following tables:

Table I

Influence of Seed Treatment on Germination (Appearance of Seedlings at Surface of Soil), Number of Mature Plants Produced, Average Weight, and Number of Days Required to Reach Maturity

Period of treatment	No. of seeds	No. germinated	Percentage germination	No. of mature plants	Percentage matured	Average weight of plants (gm.)	Days to reach maturity
Untreated	100	95	95.00	91	91.00	26.26	37
8 hours	120	97	80.83	84	70.00	24.50	38
2 days	120	76	63.33	71	59.17	22.88	38
5 days	140	46	32.86	31	22.14	17.48	43
7 days	140	7	5.00	3	2.14	16.67	48
9 days	140	1	0.71	1	0.71	14.50	46

Table II

Influence of Seed Treatment on Stem Structure

Seed treatment	Av. thickness of phloem	Av. thickness of xylem	Ratio of phloem to xylem
Untreated	0.07953 mm.	0.474 mm.	0.168
5 days in H_2O	0.11550	0.452	0.255

TABLE III

Percentage of Dry Matter and Moisture

Seed treatment	Percentage	
	Dry matter	Moisture
Untreated	16.61	83.39
5 days in H_2O	19.05	80.95

TABLE IV

Carbohydrates Expressed as Percentages of Weights of the Carbohydrates Found in Plants from Untreated Seeds; Basis of Equal Weights of Wet and Dry Matter of Samples

Seed Treatment	Weight Basis											
	Glucose		Sucrose		Total Sugars		Starch		Hemicelluloses		Total Carbohydrates	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
None	100	100	100	100	100	100	100	100	100	100	100	100
5 days in H_2O	148	129	111	94	129	111	243	223	110	93	151	131

TABLE V

Total Nitrogen, Organic Nitrogen, Amino-Acid Nitrogen, and Proteins Expressed as Percentages of Weights of These Found in Plants from Untreated Seeds; Basis of Equal Weights of Wet and Dry Matter of Samples

Seed Treatment	Weight Basis							
	Total Nitrogen		Organic Nitrogen		Amino-Acid Nitrogen		Proteins	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
None	100	100	100	100	100	100	100	100
5 days in H_2O	87	76	87	76	80	70	93	81

TABLE VI

Weight of Respiratory Carbon Dioxide Given off Per 100 GM. of Dry Matter in 10 Hours

	Seed Treatment	
	Untreated	3 Days in H_2O
Grams of CO_2.....	1.191	1.568

TABLE VII

Volume of Oxygen Liberated by Catalase Action and Percentage of Oxygen on Basis of That Liberated by Untreated Seeds; Seeds Soaked with Aeration; Volumes Corrected to 0° C. and 760 MM. Pressure; 10-Minute Runs

Seed Treatment	0.2 GM. Air-dry Material (CC.)	1.0 GM. Air-dry Material (CC.)	1.0 GM. Dry Matter (CC.)	Per-centage Oxygen
Untreated...	19.97	99.85	113.04	100.00
2 days in H_2O	19.04	95.20	108.02	95.56
5 days in H_2O	22.49	112.45	129.47	114.53

TABLE VIII

Volume of Oxygen Liberated by Catalase Action and Percentage Oxygen on Basis of That Liberated by Untreated Seeds; Seeds Soaked without Aeration; Volumes Corrected to 0° C. and 760 MM. Pressure; 10-Minute Runs

Seed Treatment	0.2 GM. Air-Dry Material (CC.)	1.0 GM. Air-Dry Material (CC.)	1.0 GM. Dry Matter (CC.)	Per-centage Oxygen
Untreated...	23.02	115.10	125.89	100.00
2 days in H_2O	20.32	101.60	111.87	88.86
5 days in H_2O	19.27	96.35	106.43	84.54

From the data it will be seen that soaking the seeds of dwarf bean in distilled water with aeration resulted in a progressive decrease in the rate of germination, in a further reduction in the number of mature plants produced, in a progressive decrease in the growth and weight of the plants produced, and in an increase in the time required for the plants to reach maturity.

In the stems there was a greater average thickness of phloem and a higher ratio of the phloem to the xylem in the plants from the soaked seeds. There was also a modification of leaf structure, the leaf blades of plants from treated seeds generally being thinner and more compact in structure than those of plants from untreated seeds.

In the plants from soaked seeds there was a marked relative increase in reducing sugars, starch, and total carbohydrates, also an increase in solid matter, and a relative decrease in total nitrogen, organic nitrogen, amino-acid nitrogen, and proteins, in comparison with the plants from untreated seeds.

Soaking the seeds before sprouting resulted in an increase in the rate of the production of respiratory carbon dioxide. The seeds sprouted after previous soaking contained 63.9 per cent of water, while those sprouted without previous soaking contained 53.7 per cent of water.

Soaking the seeds without aeration resulted in a regular decrease in catalase activity. Soaking with aeration resulted at first in a small decrease in catalase activity, but this was soon followed by a considerable increase. This modification of the result is doubtless due to the fact that the seeds when soaked with aeration passed through the early stages of germination, with a consequent increase in catalase activity.

THE CLASSIFICATION OF CONIFERALES

BY

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ABSTRACT

Several botanists have proposed raising the subfamilies of conifers to the rank of families, which seems to be more and more justified as their morphology becomes better known. In suggesting such a revision the writer would wish to retain the time-honored grouping of the conifers into the two groups formerly called the families: Pinaceae and Taxaceae. Since these two names have been retained as more restricted family names by Pilger[1] in his new classification, the writer proposes these two groups with the rank of suborders: *Phanarostrobilares* and *Aphanostrobilares*.

Phanerostrobilares are characterized by well developed and usually conspicuous seed cones. In addition to this the plants are mostly monoecious and the cones are nearly all woody; they are fleshy only among members of the genus *Juniperus*.

Aphanostrobilares have, for the most part, small or poorly developed cones, or the cones are reduced to only a few scales and usually the cone or the ovule is fleshy. Most species of this group are dioecious.

We would also propose the division of some of Pilger's seven families still further, thus increasing the number of families to ten. On embryological grounds as well as on the basis of recognized taxonomic differences

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[1] Pilger, R., 1926, in Engler & Prantl. Natürl. Pflanzenfam. 13: 163-166.

the family Sciadopitaceae should be separated from the Taxodiaceae of Pilger (= Taxodineae of Eichler), as was proposed many years ago by Arnoldi[2] and more recently by Hayata[3].

Lawson's morphological investigations of Microcachrys and of Pherosphaera[4, 5] have made it reasonably certain that these two genera have little in common and very little which would justify their inclusion with Podocarpaceae. Microcachrys and Saxegothaea may be grouped together into a family: Saxegotheaceae and the genus Pherosphaera into another family by itself: Pherosphaeraceae. With these changes the ten families may be arranged as follows:

A. PHANEROSTROBILARES
- I. *Pinaceae*—including Pinus, Cedrus, Pseudolarix, Larix, Keteleeria, Tsuga, Abies, Picea and Pseudotsuga.
- II. *Araucariaceae*—including Araucaria and Agathis.
- III. *Sciadopitaceae*—including one genus; Sciadopitys.
- IV. *Taxodiaceae*—including Cunninghamia, Taiwania, Athrotaxis, Sequoia, Taxodium, Glyptostrobus and Cryptomeria.
- V. *Cupressaceae*
  - a *Cupressoideae*—including Cupressus, Chamaecyparis, Libocedrus, Biota and possibly some of the following: Thujopsis, Fokienia, Fitzroya, and Diselma.
  - b. *Callitroideae*—including Widdringtonia, Actinostrobus, Callitris and possibly Tetraclinis.
  - c. *Thujoideae*—including Thuja and possibly some mentioned in (a) above.
  - d. *Juniperoideae*—including Juniperus and Arceuthos.

B. APHANOSTROBILARES
- VI. *Saxegothaeaceae*—including Saxegothaea and Microcachrys.
- VII. *Prodocarpaceae*—including Podocarpus, Dacrydium, Acmopyle and Phyllocladus.
- VIII. *Pherosphaeraceae*—including only one genus; Pherosphaera.
- IX. *Cephalotaxaceae*—including Amentotaxus and Cephalotaxus.
- X. *Texaceae*—including Austrotaxus, Taxus and Torreya.

Elsewhere the writer is presenting a more complete discussion of this classification together with a summary of some of the embryological as well as taxonomic characters which justify the separation of the conifers into these ten families.

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[2] Arnoldi, W., 1901. Beitrage zur Morphologie einiger Gymnospermen V. Bull. Soc. Imp. Nat. Moscow for 1901: 451-476. See 470-

[3] Hayata, B. 1931. Bot. Mag. (Tokyo). 45: 568.

[4] Lawson, A. A., 1923. Life-history of Microcachrys tetragona (Hook.). Proc. Linn. Soc. N. S. W. 48: 177-193.

[5] ———, 1923. Life-histoy of Pherosphaera. Proc. Linn. Soc. N. S. W. 48: 499-516.

SOME OBSERVATIONS ON THE FUNCTION OF CORN TILLERS

BY

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This investigation was undertaken to determine the effect of tiller-growth on the development of the main stalk of the corn plant, to determine the effect of tiller-removal on the growth of the main stalk, and to get some evidence as to whether or not translocation of food materials takes place between the tiller and the main stalk.

Yielding Ability of Tillered Plants Compared to Those Not Tillered

In order to determine the comparative yield of grain from tiller-bearing and non-tiller-bearing stalks under field conditions, a number of ears were harvested from both kinds of stalks growing in single-plant hills. The ears from stalks with tillers attached weighed more, by an average of 35 grams, or 14.5 percent, than those from non-tiller-bearing stalks. This difference was accompanied by a comparatively low probable error and by odds greater than 9999 to 1.

Elongation of Plants With and Without Tillers

There was no important difference between tillered plants and non-tillered plants in the rate of elongation at any time during the growing period. When the tillers were removed, however, the plant elongated more rapidly than did those plants to which the tillers were attached. This increase in growth rate may have been caused to some extent by wound stimulation, but it is believed that most of it was due to the main stalk using in its own development materials which would have otherwise been translocated to the tillers.

Effect of Removing Blades From the Main Stalk

In the defoliation studies, pairs of plants as nearly the same size as could be chosen were selected, one having a vigorous tiller and the other without a tiller. The blades were then removed from the main stalk of both plants by clipping as close to the stalk as possible with a pair of shears. The blades on the tiller were undisturbed.

It was found that the stage of plant development at the time the defoliation was made influenced the results greatly. Tillers attached to stalks defoliated a week before tasseling did not grow as rapidly as those attached to non-defoliated main stalks. This is believed to be due to the fact that after the main stalks were defoliated they drew upon the tillers for a part of their support. On the other hand, tillers attached to main stalks defoliated after tasseling grew much more rapidly than tillers attached to non-defoliated stalks. Complete defoliation at this stage of growth resulted in the death of the main stalk.

Main stalks which were defoliated after fertilization were greatly benefited by the attached tiller. The increase in grain yield of the tiller-bearing main stalk was over 100 per cent with high odds that the difference was not due to chance. When defoliation of the main stalk was made earlier, the benefit of the tiller was not so marked. Defoliation made

when the corn was coming into tassel was followed by no grain formation on either the tillered or non-tillered main stalk. Defoliation made a week before tasseling resulted in about 50 per cent more grain being produced on the main stalk attached to a tiller than on a defoliated main stalk having no tiller, but the odds were not high enough to indicate significance. In most cases when the tiller did not increase the yield of the main stalk, it produced a larger than average-sized ear itself. These results are in complete harmony with those obtained in some earlier experiments.[1]

Further Evidence That Translocation Occurs From Tiller to Main Stalk

The above evidence indicates that there is a translocation of food materials from the tiller to the main stalk. In order to secure further evidence, a determination of the sugar content of the tiller and main stalk was made. Samples of the stalk were collected when the grain was in the early blister stage and again at the roasting ear stage. Eight-inch lengths of stalk, about 24 inches from the base of the plant, were taken from both main stalks and tillers in the early morning. Presumably the quantity of sugar in stalks and tillers would be low at this time. Similar sections of tillers from which the supporting main stalk had been removed the previous evening were taken.

These tillers were not producing ears, and presumably the sugar content would be high, as there was no main stalk to which the sugar might have been translocated during the night. The dried material was ground until it passed through an 80-mesh sieve. Sugars were extracted by use of 90 per cent alcohol, the solution clarified, and the quantity of sugar determined by the Shaeffer-Hartman[2] iodometric titration method.

There was only a slight difference in the sugar content of the main stalk and the tiller, although usually the tiller contained slightly less sugar than did the main stalk. The quantity of total sugar in the tiller from which the main stalk had been severed the evening before, was greater in both instances than it was in the tillers which were attached to the main stalk during the night. This difference, although small, indicates that sugar in the tiller is translocated to the main stalk during the night.

Conclusions

From the data secured, it appears clear that the tiller on a corn plant can and does contribute to the development of the main stalk, under such extreme conditions as complete or partial defoliation. The slight excess in total sugar content of tillers from which translocation was not permitted to occur also suggests that tillers contribute to the main stalk through supplying carbohydrates. The higher grain-yielding ability of plants with tillers over non-tillering plants indicates that tillers may be responsible for this greater producing power.

That the influence of the tiller is beneficial is further suggested by the fact that the removal of the main stalk during the latter half of the vegetative period results in an accelerated growth of the tiller.

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[1] Dungan, George H., An indication that corn tillers may nourish the main stalk under some conditions. Jour. Amer. Soc. Agron. 23:662-670. 1931.

[2] Shaeffer, P. A., and Hartman, A. F. The iodometric determination of copper and its use in sugar analysis. Jour. Bio. Chem. 45:349-390. 1920.

THE SMALL FRUIT VARIETY QUESTION IN ILLINOIS

BY

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There is an increasing interest in small fruit culture in Illinois from the standpoint of the commercial grower, the home gardener, and the plant breeder. During the past few years, Illinois-grown red raspberries and strawberries have been commercially profitable where attention was given their culture. Many home owners are turning to the small fruits as a source of healthful and appetizing food easily and quickly provided on a small piece of ground, but hesitate to plant, not being familiar with the varieties best likely to succeed.

Although small fruits are rich in varieties (during the past century nearly 2,000 strawberries having been named and introduced, with a corresponding large number of the other small fruits), many have been short-lived because they were either unproductive or unable to stand the environmental conditions.

Although small fruit breeding offers a fertile field for the plant breeder in developing better varieties, much of the most careful work has been done since 1900, most horticulturists being content to take the best that they found in the wild and propagate from it. Notable exceptions in Illinois horticulture include the late Reverend J. R. Reasoner, who will always be honored as the originator of the Dunlap and Burrill strawberries, and the late E. A. Riehl, whose Eclipse and Delicious grapes are recognized as having high quality.

Projects are now well under way by the U. S. Department of Agriculture, State Experiment Stations, nurserymen, and private individuals looking toward the improvement of old, and the origin of new varieties of gooseberries, raspberries, strawberries, grapes, and other small fruits. Worth while new varieties bear more and better fruits. The plants have greater vigor and more resistance to disease and to unfavorable weather conditions.

Among the projects in pomology at the Illinois Experiment Station, mention should be made of those which have to do with gooseberry and raspberry breeding and the testing of the old and new small fruit varieties in the trade. In the small fruit breeding work a search is being made for a gooseberry which bears larger and better fruits on canes comparatively free from spines and with foliage more resistant to leaf diseases. More than 30 varieties of American and European gooseberries have been selfed and crossed at blossoming time in the variety plantation at the Station. Plants are being grown from the seed secured and detailed studies are being made of their horticultural and botanical characters. Some of the best individuals are being back crossed with the parents. This work was begun in 1924 and at this time over 4,000 seedlings are under test, including several hundred of the second and third generation. A number of promising individuals have been found among the thousands of plants now coming into bearing. Columbus x Carrie and Poorman x Transparent progenies are very promising as to fruit and plant characteristics. Glenndale and Carrie, among others, when selfed, gave a number of seedlings with better plant or fruit characteristics than the parents.

Raspberry breeding work was begun at the Station in 1922. There are now growing more than 7,000 individuals including second and third generation selfs and crosses. Search is being made for more hardy, disease resistant, and productive raspberry varieties and considerable material is also available for study of the inheritance of characters.

Striking differences are being found in hardiness, vigor, and anthracnose resistance of the seedlings, as well as in the size, quality, and amount of fruit borne on individual bushes. In many cases where selfing was done, some of the resistant seedlings were superior to the parents in fruit or cane characters or both. Very promising selfed seedlings of Quillen, Cumberland, Plum Farmer, Honey Sweet, Gregg, Black Pearl and Munger have been found. In combinations among the blackcaps, some outstanding individuals have resulted, especially in the Honey Sweet-Plum Farmer and Munger-Honey Sweet crosses. Plum Farmer-Honey Sweet progeny do not rank so high as the reciprocal, although a few individuals were worth keeping. Occasional hybrid purples resulting from crosses made between blackcaps and reds are very promising, including several Quillen-Latham and Quillen-June. These striking diversities shown between varieties and seedlings are thought to be good evidence of physiological individuality, which is inherited. Further tests are under way to determine the value of the potential new varieties.

A number of small fruit varieties, most of them available for general planting, have been tested for a period of years at the Station and may be recommended. In one group may be listed those probably chance seedlings whose value was appreciated by some interested plant lover and sent out to the trade through nurserymen. This list includes the Plum Farmer, Cumberland, and Quillen black raspberries, the Royal Purple raspberry, the Eldorado blackberry, and the White Grape current. Plum Farmer and Cumberland are now losing in popularity because of susceptibility to anthracnose, requiring careful spraying for its control.

The second group of varieties has resulted from the efforts of plant breeders interested in originating new varieties for a particular purpose. Some of the outstanding introductions in this group found adapted to Illinois conditions are the Dunlap, Burrill, Howard 17 (Premier) and Aroma strawberries; the Wilder current; the Poorman gooseberry; and the Agawam (red), Concord (black), Niagara (green), and Brighton (red) grapes. The Premier strawberry is rapidly supplanting other varieties because of its productiveness. It is a better shipper but not so high in quality as Dunlap or Burrill. Agawam and Niagara are doubtfully hardy in northern Illinois. Poorman is rather slow in coming into full bearing and is not so productive as some older sorts but the fruit is large and of high quality.

A considerable number of small fruit seedlings from other experiment stations, some of which have been named recently, are being tested at the Illinois Station to determine their merit in this state. It is too soon to judge the value of the most recently obtained material. Some of the varieties in this group which have demonstrated fitness for Illinois planting include the following grape varieties which originated at the New York (Geneva) Station, arranged in order of their ripening season: Ontario and Portland (green), Sheridan (black), and Urbana (red). Of these grapes, Portland bids fair to supersede other early green varieties and Sheridan promises to be more popular than Concord, due to their productiveness and the size and quality of their fruit.

In the raspberry varietal list, two reds from the Minnesota Station, the Latham and the Chief are rapidly becoming the most popular in this section of the country. They are superior in productiveness to Cuthbert

and King, older standard sorts. The ripening season of Chief begins about a week before that of Latham. The Ulster, a new red seedling from the Geneva Station, is very promising.

Among the new strawberries, the Blakemore, Bellmar, and Redheart varieties, early to midseason, originated by the U. S. Department of Agriculture and now available from cooperating nurserymen, promise to supersede some of the older varieties for home and market. The plants are vigorous and productive. Blakemore is recommended for canning and preserving. Bellmar and Redheart rank high in dessert quality.

AN EVALUATION OF BUD SPORTS IN THE APPLE

BY

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In vegetative propagation as encountered in horticulture, a biological process like cell division is put to a severe test. A clone—or variety—is usually defined as a group of individuals derived by asexual cell division from a single ancestral zygote. According to this definition, the cells which go to make up all of the plants of a variety are descended by somatic division from the original zygote from which came the seedling constituting the original plant of the variety. How many cells in a thousand acres of Concord grapes or Elberta peaches?

The outstanding feature of a variety planting is the great uniformity with which the process of cell division is carried forward, yet departures from the normal process do occur. Although they are relatively few, nevertheless more might be expected in view of the almost numberless times the chromosomes of the original zygote must be built up by growth processes and fractionated again in cell division. The constancy of this process so often repeated determines or underlies the uniformity of a variety.

It is those variations having a genetic basis in which we are particularly interested. In growth or cell descent as encountered in the fruit clones, at division each chromosome and each gene of the male and female complement must be equationally divided if the variety is to be held true to type. The different allelomorphs may be made up of two dominant or two recessive factors or a dominant and a recessive factor. A horticultural character such as color or size may be the expression of a large number of factors regardless of the number of chromosomes on which they may be carried. There is a background and a mechanism, then for adding to or subtracting from the original genetic combination of the parent zygote. It would seem that in somatic division whether the double, triple or any other chromosome multiple be present, a number of factor changes are possible. The mutation process in clones is probably similar to non-disjunction as in the heterotypic division in that it is possible for a single factor or more, or a single chromosome or more, to be affected.

As bud sports are so likely to be found by practical men, the more obvious types of departure from the normal would be expected to be observed most frequently. Characters such as deepened color, russeting, cut leaves, thornless branches, early or late ripening, quality changes, and giant fruit forms have been of fairly frequent mention. There is no reason why a large number of characters in addition to these should not be affected by somatic mutations. A more critical study of our fruit clones

will undoubtedly show this to be the case so that both the desirable and the undesirable bud sports of far-reaching consequence may be expected to occur.

Nor is this the end! If a bud sport possessing commercial value arises from a clone, why not in a bud sport which has, in turn, become the starting point or parent stock of a new clone? This has actually happened in some of the color sports and may be expected to occur in other characters as well.

Bud sports in the apple: In "The Apples of New York," Beach mentions Collamer as originating as a sport from Twenty Ounce. This variety was propagated as early as 1900. The Gano and Black Ben Davis are looked upon by some as bud sports of Ben Davis, but there is considerable doubt as to whether this is the case. While there was some activity in the twenty-year period or so following 1900 in selecting superior strains in the different fruits, one of the next dark-colored types reported as a bud sport from a known apple variety was the Red Duchess. The next "big sport" to occur was Starking from Delicious about 1920 or 1921. The following list, based in part upon a statement kindly furnished by Mr. J. T. Bregger, of the Washington Experiment Station[1] will illustrate the activity and interest in red color sports in the apple within the last decade or so.

The varieties are arranged in the order of the number of color sports so far reported and is admittedly incomplete.

Delicious	50	McIntosh	7	Ben Davis	2
Winesap	29	Spitzenberg	5	St. Lawrence	2
Rome	18	Baldwin	4	Chenango	2
Spy	11	Jonathan	4	Rambo	2
Stayman	9	Twenty Ounce	4	Winter Banana	1
Duchess	9	Willow	3	Westfield	1
Fameuse	8	Red Astrachan	3	Wealthy	1
Gravenstein	8	King	2	Summer Queen	1
Stark	7				

In addition to these, russet sports have been found in Golden Delicious and Grimes; giant sports in Jonathan and Rambo; and a "long hanging" or late maturing sport in Jonathan. The summary might be extended, but the data presented are sufficient to show the present trend in this direction.

Naturally, this movement brings up problems. The technique of testing bud sports needs study. The new types will have to be tested, compared, and the inferior ones eliminated. In some of these sports more has been accomplished to increase the level of color in the crop as a whole than can be brought about by the combined result of cultural practices. Care must be taken, however, not to expect too much in this direction. It should not be assumed, in selecting a bud sport on the basis of color, that other characteristics such as vigor or yield have not also been affected by mutation. On the whole, considering the immense background of inferior types from controlled crosses, bud sports of various types promise to be a fruitful method of improving clones. The grower—especially with tree fruits—is confronted with a practical problem in keeping the producing units up to date with thoroughly tested offerings from this direction. The whole should, therefore, be given careful genetic analysis, as well as an appraisal from the horticultural standpoint.

[1] Personal correspondence, February 6, 1932.

THE PERCENTAGE AND PERSISTENCE OF POLYEMBRYONY IN CERTAIN CITRUS FRUITS

BY

MARGARET M. ESSER

Rosary College, River Forest, Illinois

ABSTRACT

Previous workers have reported polyembryony in a number of fern and seed plants. Polyembryony in citrus fruits was studied by Strasburger (1878), Webber (1900), Osawa (1912), Ensign (1919), and Frost (1926). In this investigation polyembryony was studied in four species, namely: *Citrus senensis, C. nobilis delicosa, C. grandis, and C. limonia.* One hundred seeds of each species were germinated to determine the number in which supernumerary embryos were initiated, and one hundred seeds were planted to determine the number in which polyembryony persisted after the seedlings were well established in soil. The species which showed the highest percentage polyembryony was *C. senensis* in which there was 92 per cent; *C. nobilis delicosa* showed 84 per cent; *C. grandis,* 69 per cent; and *C. limonia,* 29 per cent. Although *C. limonia* has the lowest percentage polyembryony, some of the seeds which showed it contained the highest number of embryos. (One lemon seed contained seven supernumerary embryos.) While the number of seedlings which show persistent polyembryony is less than the number which initiate them in each species, the proportionate number is consistent with the number initiated. No seedling in any case was observed which showed more than one persistent supernumerary plant.

ECOLOGY OF ASCOMYCETES OF THE CHICAGO REGION

BY

V. O. GRAHAM

Chicago, Illinois

ABSTRACT

In so diversified an area as the Chicago region where widely varying physical factors are operating, much of ecological interest may be found. It is doubtful whether fungi play a major role in the dynamic changes which constantly occur, yet the slight soil changes caused by fungi may be of great importance in opening the way for other forces to operate. Fairy rings of the commercial mushroom *(Pasolliota campestris)* often circumscribe a brown grassy area in a field of very green grass, especially on golf courses. It is also true that leaf mold in the forest is often bound together by a network of mycelium, the enzymatic action of which is rapidly transforming such vegetable compounds into others of simpler chemical composition. In turn this new material penetrates more readily into the soil and forms a food medium for multitudinous species of soil organisms.

The occurrence of Pezizaceae, Morchellaceae, and Helvellaceae is of considerable interest from the standpoint of time. In general vernal fungi are small species, but the species of *Peziza, Morchella,* and *Gyromitra,* all of which are vernal, are as large as the autumnal species which belong to the genus *Helvella.*

In the spring the soil is relatively cold even in open fields and open areas in the forest, and much colder in the more shaded, leaf covered soil of the deeper parts of the forest. The blanket of leaves in the depth of the forest prevents an early rise in temperature. Here fungi are absent but fungi may be looked for in open areas where the leaf covering is thin or absent. This leaf covered habitat, which is too cold for fungi during spring, is densely populated with autumnal species, for the leaves retain the heat and moisture, both of which are necessary for the development of fungi.

Among the vernal species of fungi may be listed the following for the Chicago region: On the ground in open woods during May in the Indiana Dunes State Park may be found: *Peziza sylvestris* Boud., *P. badia* Pers., *P. acetabulum* L., *P. onotica* Pers., and *P. aurantia* Pers. On partly buried sticks, or on very moist logs in the Glenview forest preserve may be found during April, *Peziza coccinea* Jacq.; in the same habitat during June, *P. floccosa* Schw., and *P. occidentalis* Schw. *Peziza rutilans* Fr. is found among mosses in woods of hydrarch succession (elm to beech) April 30. *P. domiciliana* Corde. occurs on soil in basements. *P. venosa* Pers. occurs on the ground under beech trees both at Smith and at Chesterton, Indiana, during early May. It is reported by Seaver as occurring from New York to Ohio. *P. repanda* Pers. may occur on decayed logs in beech woods, on soil in greenhouses, or on soil in rich woods.

In bogs on decaying logs occurs *Patella scutellata* (L) Morgan, and on the ground *Patella umbrorum* (Fr) Seaver during May.

Peziza vesiculosa Bull. is our most common dung-inhabiting cup fungus. *P. violacea* Pers. occurs on burned over ground in the dunes during May.

About May first *Gyromitra esculenta* Fr. occurs on the ground in pine woods. About the same time on flood-plains and in moist woods adjacent to swamps occurs *G. brunnea* Underw. Both were found near the east end of the Indiana Dunes State park.

Morchella is well represented in this region; *M. crassipes* Pers. has been found under Hawthorn trees in the Deer grove forest preserve. In grassy places *M. esculenta* Pers. and *M. deliciosa* Fr. occur during May. *M. conica* Pers. and *M. hybrida* (Sow) Pers. occur in open woods in the dunes state park. *M. angusticeps* Pk. grows in the pine woods of the same locality. All belong to the month of May. *Verpa conica* Mull. appears occasionally in May along the swamp edge of the park. During autumn and occasionally in early spring in the poorly drained, moist flat woods at Thornton may be found *Helvella atra* Oed., and *H. cripa* may be found in September in the pines of the state park.

Other ascomycetes are closely related to a very special habitat. *Cordiceps herculea* developes within a large white larva producing death of its insect host at which time it erects a monument-like fructification from the body of its dead host.

Growing on wood are a number of species including *Xylaria polymorpha* and *Xylaria corniformis*, *Hypoxylon rubiginosum* Fr., *Daldinia concentrica* Bolt., and *Bulgaria inquinans* Fr. *Geoglossum glutinosum* Pers. occurs occasionally on buried wood in the rich woods of the Dunes State Park, and *Leotia lubrica* Pers. of the same locality grows on moss near swamps during August.

Summary

Ascomycetes are predominately vernal. Vernal fungi prefer open habitats with but little leaf cover whereas the abundant autumn fungi occur in deeply shaded, humus covered areas. Although autumnal fungi are at least one hundred times as abundant as vernal fungi, but few ascomycetes are present.

THE PHYSIOGRAPHIC AND HORTICULTURAL ECOLOGY OF THE BEVERLY (BLUE ISLAND) RIDGE

BY

ELDRED E. GREEN

Chicago, Illinois

One of the prominent features of the Chicago lake plain is the moraine situated about thirteen miles south-southwest of the mouth of the Chicago River. During the last glacial period this moraine was an island in Lake Chicago. The name Blue Island, which was applied to it by early settlers, was doubtless due to its island-like appearance and not to its geological history.

When a settlement grew up on the moraine the name of the region was applied to it as a matter of course. Later, political subdivisions occurred and the moraine came to contain the towns of Blue Island, Morgan Park, and Beverly Hills. The latter two are now included in the corporate limits of Chicago and are known collectively as the Ridge, Beverly Ridge, or Beverly Hills district. Inasmuch as the Beverly Ridge district is closely confined to the actual moraine, and as it includes over two-thirds of the total length of the hill development, it seems better to substitute the term Beverly Ridge at the present time for that of the now less descriptive one of Blue Island.

The Beverly Ridge includes the actual moraine, the sand dunes partially covering it on the western slope, and the immediately adjacent lake plain on the east. These three physiographic features give three different soils within a short distance and so should show the effect of the soil upon the vegetation.

The Beverly Ridge was a forested area at the time of the settlement of Illinois. The forest extended over all of the soil types with no differences. It is a typical oak-hickory mesophytic forest as described for this region by Dr. Cowles[1], Miss Schmoll [2], Mr. DeForest[3], and others. This forest association is either a pre-climax or climax stage. The trees do not give any clue to a succeeding association but the undergrowth contains some species that occur in the beech-maple climax forest. Otherwise the forest contains those species usually found in the oak-hickory association. The presence of these smaller species usually found in mesophytic forests means that the oak forest was quite mesophytic and one type of climax, or that these species were forerunners of another association.

It is difficult to believe that the undergrowth would appear in advance of the trees with which they are usually associated. Such plants generally follow the trees because of the greater degree of mesophytism made possible by the growth of the trees. Therefore the only possible conclusion is that the forest at this time is mesophytic enough to support plants of the climax association. No native trees of the beech-maple forest are found here in any stages.

The origin of the forest on the lake plain is summed up in the following quotation[4]. "There is evidence that the lake plain at the 87th street forest preserve underwent a hydrarch succession. The vegetation that supports this view consists of an extensive stand of *Quercus bicolor*, *Viburnum lentago*, *Sambucus canadense*, *Crataegus mollis*, *Crataegus punctata*, *Tilia americana*, and relicts of *Onoclea sensibilis*. Many of these species

may be found in mesophytic forests but the quantity and denseness of the stand gives the appearance of a mature fen or flood-plain forest rather than a mature xerarch one. The presence of *Quercus velutina, Quercus macrocarpa,* and *Cornus racemosa* indicate that the forest is not now swampy."

As a corollary and supplement to the physiographic studies of the Beverly Ridge a similar study of the horticultural plants was undertaken. In order to reduce variable factors only woody plants growing in the native soils were used. The final list contained one hundred and twenty species classified by soils. This study, using several times as many species as the physiographic one on native plants, confirmed the previous findings. In addition to the confirmation of the general physiographic ecology, the horticultural study produced some other information of ecological importance.

The following excerpt points out some of this interesting ecological material[4]. "Ecologists have admitted for a long time that different soils may eventually support the same plant association. Soil differences, however, have been called upon to explain the different associations in a succession on the same soil . . . Plants from different associations are found growing from comparative infancy to maturity in the same soil and under the same edaphic conditions. If differences in humus content, soil moisture, aeration, minerals, and acidity were significant in causing succession, then the mixing and blending of plant materials from different associations in artificial plantings would be impossible. The presence of thriving specimens of oaks, elms, maples, pines, and poplars in the same planting shows that soil differences are not significant in plant growth."

While the above extract only points out the more obvious examples of associational blending, such examples can be multiplied almost indefinitely. They include examples of widely distributed plants and narrowly distributed ones, some plants beyond their normal geographic ranges and others well within them.

The blending of hydrarch and xerarch associations occurs as well as blending of the associations in the successions. The most conspicuous case of this kind is in one planting where *Cephalanthus occidentalis* and *Hamamelis virginiana* occur side by side in full exposure.

From such horticultural evidences and from the physiographic ones, it is apparent that the three soils of the Beverly Ridge do not influence the distribution and growth of the native and introduced plants. Limiting factors, therefore, must occur in the seedling stage as they are ineffective on the transplanted plants. It is obvious also that the horticulture of a region can be used to test ecological theories as gardeners and landscapers do not usually work according to botanical laws or theories. A more extensive and intensive development of this field should prove fruitful to botanists and horticulturists alike.

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A REPORT OF MOSSES COLLECTED FROM COLES AND CRAWFORD COUNTIES, ILLINOIS

BY

STELLA M. HAGUE and STELLA A. HOLMES

University of Illinois, Urbana, Illinois

These mosses represent the number of species that may be found in rather casual collections from restricted areas. The Coles County collections, with the exception of *Polytrichum*, were from two regions: the first, one half mile east of Charleston from a ravine (locally known as Endsley's Ravine) which enters Embarras River; the second, from a pasture a mile south of the city through which a creek flows at the base of low hills covered with a young forest. The Crawford County collections were made from two farms north of Robinson in the transition region between native forest and prairie. The names used are those found in A. J. Grout's "Mosses with a Handlens and Misroscope" and "Moss Flora of North America", Vol. III, part 1 and Vol. III, part 2.

POLYTRICACEAE

Catherinea angustata Brid.
Coles, 11-9-31; Crawford, 3-9-31. Forest floor and roadside banks.
Catherinea undulata (L.) W. and W.
Coles, 11-9-30; Crawford, 3-25-32.
Polytrichum sp.
Coles. Dry hill.

FISSIDENTACEAE

Fissidens incurvus var. minutulum Austin
Coles, 9-29-29. Rocks in stream.
Fissidens subbasilaris Hedw.
Coles, 11-11-30. North slope of hill.

DICRANACEAE

Ceratodon purpureus (L.) Brid.
Coles, 3-26-32. Dry soil.
Dicranum scoparium (L.) Hedw.
Coles, 11-11-32. Hill top and north slope.
Dicranella rufescens (Dicks.) Schimp.
Coles, 11-11-29.
Ditrichum pallidum (Schreb.) Hampe
Coles, 8-15-29. Crawford, 9-30. Dry soil.
Leucobryum glaucum (L.) Schimp. Sterile.
Crawford. Hillside.

TORTULACEAE

Barbula unguiculata (Huds.) Hedw.
Coles, 11-11-29. Fallen tree.
Tortula marginata (B. and S.) Spruce
Crawford, 5-13-30. Rocks around flower bed.

ORTHOTRICACEAE

Orthotrichum ohioense S. and L.
Crawford. Dead bark.

FUNARIACEAE

Funaria hygrometrica (L.) Sibth.
Coles, 11-7-29. Concrete step. Crawford, 5-30-29. Soil with gravel.
Physcomitrichum turbinatum (Mx.) Brid.
Coles, 11-9-29. Clay bank. Crawford, 5-13-30. Garden soil.

AULACOMNIACEAE

Aulacomnium heterostichum (Hedw.) B. and S.
Coles, 9-29-29. Ravine.
Aulacomnium palustre Schwaegr. Sterile
Crawford, 2-25-32.

BARTRAMIACEAE

Bartramia pomiformis (L.) Hedw.
Coles, 11-11-29. Ravine in woods.

BRYACEAE

Bryum caespiticium L. Sterile
Coles.
Mnium cuspidatum (L.) Leyss.
Coles, 10-9-29. Crawford, 3-25-32. Soil.
Mnium rostratum Schrad. Sterile.
Coles, 10-9-29. Crawford, 3-25-32. Soil.

LESKEACEAE

Anomodon apiculatus B. and S. Sterile
Crawford, 3-25-32. Base of tree.
Anomodon attenuatus (Shreb.) Hueb. Sterile
Coles. Crawford, 3-25-32.
Anomodon rostratus (Hedw.) Schimp. Sterile
Crawford, 3-25-32.
Leskea polycarpa Ehr.
Coles, 9-23-29. Crawford, 9-30. Tree.
Leskea obscura Hedw.
Coles, 9-30.
Thuidium delicatulum (L.) Mitt. Sterile
Coles, 11-9-29. Crawford, 3-25-32.
Thuidium microphyllum (Sw.) Best.
Crawford, 10-6-28. Rotten log.

HYPNACEAE

Amblystegiella confervoides (Brid.) Loeske
Coles, 10-3-29. Rock in creek.
Amblystegium riparium B. and S. Sterile
Leptodictyum riparium (L. Hedw.) Warnst.
Crawford, 3-25-32.
Amblystegium serpens (L.) B. and S.
Crawford, 6-28-29. Tree.
Amblystegium varium (Hedw.) Lindb. Sterile
Crawford, 2-28-29. Soil woods.
Brachythecium acutum (Mitt.) Sull.
Coles, 10-3-29.
Brachythecium oxycladon Brid. Sterile
Crawford, 3-25-32.
Brachythecium rutabulum (L.) B. and S. Sterile.
Crawford, 3-25-32.
Brachythecium salebrosum (Hoffm.) B. and S. Sterile
Coles, 10-3-29. Crawford, 3-25-32.
Bryhnia Novae-Angliae (B. and Lesq.) Grout.
Crawford, 3-25-32. Soil.
Campylium chrysophyllum (Brid.) Bryhn. Sterile
Crawford, 3-25-32. Rotten log.
Campylium hispidulum (Brid.) Mitt. Sterile
Crawford, 3-25-32. Rotten log.
Climacium Kindbergii (R. and C.) Grout. Sterile.
Coles, 8-15-29.
Eurhynchium hias (Hedw.) J. and S. Sterile
Coles, 5-1-29. Crawford, 3-25-32. Soil.
Eurhynchium serrulatum Hedw.
Coles, 8-15-29. Soil.

Entodon cladorrhizans Schimp.
Coles, 11-9-30. Fallen tree. Crawford, 3-25-32. Base of tree.
Entodon seductrix (Hedw.) C. M.
Coles, 10-3-29. Crawford.
Hypnum Patientiae Lindb.
Crawford, 3-25-32.
Platygyrium repens (Brid.)
Coles. Crawford, 3-25-32. Rotten log.
Raphidostegium adnatum (Mx.) B. and S.
Coles, 9-29-29. Log.

LEUCODONTACEAE

Leucondon julaceus (Hedw.) Sull.
Crawford, 9-30. Bark of fallen tree.

A CONTRAST OF PLANT HABITATS, WITH REFERENCE TO HYDROGEN-ION CONCENTRATION AND PLANT DISTRIBUTION

BY

JEROME ISENBARGER

Crane Junior College, Chicago, Illinois

INTRODUCTION

It has occurred to the writer in the study with regard to soil acidity of various plant habitats in Illinois, Wisconsin, and Indiana, that there is a definite relation between the hydrogen-ion concentration of the soil and the nature of the underlying sub-soil strata and that this is reflected in the character of the vegetation which the habitat supports.

Two typical plant habitats in Illinois are selected to illustrate these relations. One is in the flatwoods of the Thornton forest preserve located 22 miles south of Chicago, the other is a young bog at the west end of Cedar Lake, near the village of Lake Villa in Lake County.

THORNTON FOREST PRESERVE

The Thornton region is a part of the Chicago plain. It is underlain by dolomitic limestone which crops out in some places and in others is covered to a considerable depth by rock waste and glacial drift. In the particular spot studied the depth of the surficial material has not been determined. The topography of the region is flat, variations occurring in the form of flat land a few feet below the general surface.

Two soil profiles were studied in the Thornton woods, one within a flat depression, and the other several hundred feet distant where the surface is slightly higher. The top soil at the point where the first profile was studied is a dark brown mixture of organic material and fine sand. Above this is a layer, several inches thick, of partly decayed vegetation, made up mainly of leaves from oak trees. Extending from a foot below the surface to an undetermined depth, the material is fine sand. The character of the adjacent region indicates that the sand is underlain by yellow clay. The soil is poorly drained and always moist, yet it is saturated with water only during extended rainy seasons, and is fairly well aerated during the greater part of the year. The conditions which favor acid formation here are the presence of decaying vegetation, consisting mainly of oak leaves, infusions of which have a marked acid reaction, and a deep, silicious sub-soil. Acid accumulation may occur in this type of habitat, due to the fact that basic compounds are not present to neutralize the acids.

At the higher location in the Thornton woods, where the second profile was studied, the material is Miami silt loam, sandy near the surface, but grading rapidly into clay. There is very little undecomposed leaf deposit, the organic matter being in an advanced state of decomposition. The drainage here is good, for this region, and although the presence of decomposing vegetable matter and silicious soil favor acidity, there may be a constant leaching of materials to the clay subsoil where the acids are neutralized by basic carbonates so that the hydrogen-ion concentration changes from acid at the top to alkaline at a depth of two and a half feet.

CEDAR LAKE BOG

In the Cedar Lake bog the peat at the point studied is about 12 feet deep and overlies a substratum of calcium carbonate in the form of marl. The peat is always saturated with water. Sphagnum, which is highly acid, forms the principal part of the peat. Poor drainage, poor aeration, and presence of decomposing Sphagnum and other plain materials, all favor the production of acid. The soil profiles, however, do not show high acidity except within a few inches of the living Sphagnum. Downward from this point throughout the saturated peat, the readings range from slightly acid to neutral or even slightly alkaline. In the part of the bog covered with tamarack trees and without Sphagnum, the surface shows only slight acidity. The neutral or near neutral condition evidently results from reaction with calcium bicarbonate which could diffuse freely upward from the marl substratum.

METHODS

In studying the Thornton profiles, holes were dug with a spade and samples were taken from the vertical sides. A peat sampler was used in the Cedar Lake bog to get material from the different depths down to the marl. All hydrogen-ion readings were taken in the field at the time the samples were taken. In general, the colorimetric method, using the Morgan soil-testing outfit, seemed sufficiently accurate, but results were checked from time to time by means of a portable electric set-up using the quinhydrone electrode.

The severe acid conditions of the lower Thornton habitat are reflected in the character of the vegetation. The number of species is limited to the few that can tolerate the conditions of this exceptional habitat. The trees are practically limited to oaks, *Q. rubra*, *Q. alba*, and *Q. ellipsoidalis*, and the black gum, *Nyssa sylvatica*. Many of these oaks, in various stages of development, have died within the past few years. Others of those which remain are in poor condition. The black gum seems fully fitted to cope with the conditions as they are at present. A low-growing species of *Sphagnum* is found in patches. The ferns, *Osmunda regalis* and *Osmunda cinnamonea* are thriving.

The higher Thornton habitat supports a vegetation consisting of the species found in the lower woods and in addition, a number of ferns and other herbaceous plants, the blueberry, *Vaccinium pennsylvanicum*, and *Sassafras variifolium*. The trees are in excellent condition. There is no evidence of deleterious effects of acid on any of the vegetation.

The plants of the Cedar Lake bog include a comparatively few species. Typical bog plants, as *Sphagnum acutifolium;* cranberry, *Vaccinium macrocarpon;* sundew, *Drosera rotundifolia;* pitcher plant, *Sarracenia purpurea; Betula pumila*, and tamarack are growing here and are in excellent condition.

CONCLUSIONS

(1) In poorly drained silicious soils, as in the lower Thornton flatwoods, acids formed in the decomposition of vegetation near the surface

gradually pass to the lower strata. If the substratum is silicious to a considerable depth, there is an accumulation of acids which limit the plants of the habitat to the species most tolerant to acid.

(2) In well-drained soils where acids are formed in the presence of decaying organic matter, these acids are removed by leaching to the lower strata. If calcium and magnesium bases are present in the sub-soil, acids are neutralized and the accumulation of a marked excess is prevented.

(3) In water-saturated peat underlain by calcium carbonate, there is formed, in the presence of acidulated water, the bicarbonate, which readily diffuses upward, reducing acidity by buffer action or neutralization.

(4) Hydrogen-ion concentration is the dominant factor in limiting the vegetation in the lower acid flatwoods of the Thornton forest preserve.

(5) Aeration is the dominant factor in the determination of the character of the vegetation of the Cedar Lake bog.

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RECENT STUDIES OF THE MORPHOLOGY OF PLANTS FROM THE PENNSYLVANIAN OF ILLINOIS

BY

A. C. Noé

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Recent investigations by Ellys Butler,[1] Inez M. Clark,[1] Fredda D. Reed,[1] A. C. Noé,[1] J. H. Hoskins,[2] and Harriette Krick,[3] have dealt with certain structures of Upper Carboniferous plants as preserved in Illinois coal balls.

Such are: (1) leaves of Calamites, Lepidodendron, Sigillaria, and Cordaites; (2) stems of Sphenophyllales, Lycopodiales, and Filicales; (3) cones of Lepidodendron; and (4) seeds of Cycadofilicales and Lycopodiales.

The information obtained from coal balls and fossil plant impressions from Illinois was recently utilized in the reconstruction of a forest as it may have existed in northern Illinois during Upper Carboniferous times. This reconstruction in natural size which was made under the supervision of Dr. Dahlgren may be seen at the north end of Graham Hall in the Field Museum of Natural History in Chicago. It contains the following species:

EQUISETALES:
- Calamites suckowi Brongniart
- Annularia stellata (Schlotheim) Ward
- Annularia radiata (Brongniart) Sternberg

SPHENOPHYLLALES:
- Sphenophyllum emarginatum (Brongniart) Koenig

LYCOPODIALES:
- Lepidodendron clypeatum Lesquereux
- Lepidodendron obovatum Sternberg
- Lepidodendron sternbergii Brongniart
- Lepidostrobus ovatifolius Lesquereux
- Sigillaria saulii Brongniart
- Sigillaria scutellata Brongniart
- Sigillaria reniformis Brongniart
- Lepidophloisos acadianus Dawson
- Stigmaria ficoides (Sternb.) Brongniart

FILICALES:
- Psaronius stem
- Megaphyton stem

PTERIDOSPERMS:
- Neuropteris heterophylla Brongniart
- Neuropteris decipiens Lesquereux
- Cyclopteris leaves
- Medullosa stem
- Trigonocarpus seed
- Lyginoperis oldhamia Binney
- Neuropteris Hoeninghausi Brongniart
- Lagenostoma ovoides Williamson
- Mariopteris muricata (Schlotheim) Zeiller

GYMNOSPERMS:
- Cordaites borassifolius (Sternberg) Unger

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[1] To be published in a monograph of the Illinois State Geological Survey.

[2] Contribution to the coal measure flora of Illinois. American Midland Naturalist 12, pp. 154-163. 1930.
Structure and classification of certain cycadofilicinean roots from the McLeansboro formation of Illinois. Ibid., pp. 533-551. 1931.

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THE DEVELOPMENT AND DIFFERENTIATION OF TISSUES IN THE STEMS OF GRASSES

BY

E. L. Stover

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ABSTRACT

This paper is a study of the development and differentiation of tissues in four species of grasses whose mature structures show marked differences in the arrangement of the vascular strands. Those chosen for study are: vascular strands in a single circle as shown by *Agropyron*, strands in two to five circles as in *Spartina* and *Calamovilfa*, and strands scattered as in *Zea* and other *Andropogoneae*. Variations show a definite trend of vascular evolution with the scattered bundles as the highest type in the series. All the grasses studied so far have a cortex and stele, although in the scattered bundle type this is not evident in the mature stems. Within the bundle there is considerable variation in the number of water tubes because of the varying degrees of elongation of the stem.

PLEISTOCENE FORESTS OF CENTRAL ILLINOIS

BY

John Voss

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ABSTRACT

The character of the plant life which prevailed during the interglacial stages is a field which as yet is scarcely at all developed. In some counties of central Illinois, buried peat beds belonging to third or Sangamon interglacial stage have been exposed by streams. All the peat beds examined rest directly upon Illinoian till and were covered with soil consisting of Peorian loess and Wisconsin gravel and till, the cover sometimes being eighty feet thick. In an exposure near East Peoria, Illinois, the peat is ten feet thick and contains many leaves and trunks of trees in a good state of preservation. A pollen analysis and a study of the macroscopic plant remains was made of peat from three widely separated exposures with the hope of determining the type of climate which existed during the Sangamon stage. A study was also made of the macroscopic plant remains from near the upper surface of the Peorian loess.

From this study it is evident that the climate of central Illinois during the Sangamon and Peorian stages was favorable for the growth of a more boreal vegetation than at present.

PAPERS IN ECONOMICS

Extract From the Report of the Section Chairman

"Taxation" was the general subject around which centered the articles and discussions of the Economics Section. The three artices were:

"Cook County Finances," by Herbert D. Simpson, Northwestern University, Evanston.

"Waste Through Multiplicity of Governmental Units," by Simeon E. Leland, University of Chicago.

"A Balanced Revenue System," by M. H. Hunter, University of Illinois, Urbana.

Discussions were conducted by Mr. Joseph N. Fouchard, Taxation Committee, Northwest Federation of Improvement Clubs; Mr. Clarence E. Ridley, The International City Managers' Association, Chicago; and Mr. Douglas Sutherland, The Civic Federation.

Maximum attendance at the section meeting was seventy-five, average was sixty.

No chairman for the next meeting was elected but Dr. E. L. Bogart, University of Illinois, was authorized to select a chairman after the place of the 1933 meeting had been determined.

(Signed) E. L. Bogart, *Chairman*

A BALANCED REVENUE SYSTEM

BY

M. H. HUNTER

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The multiplicity of political units, of which there are some 16,000 in Illinois, complicates the problem of public revenues and expenditures. The present revenue system of Illinois, for both state and local purposes continues to be built around the general property tax in contrast to that found in many other states.

In the last few years we have heard great condemnation of our tremendous tax burden. Yet in 1929, Illinois had the lowest per capita expenditure of any state for operation and maintenance of its general departments while but 5.97 per cent of the social income was taken in taxes for state and local purposes. In comparison with other states this was very low. As among the different classes the tax burden has been very unequally distributed. Investigations have shown that agriculture has been burdened excessively while the tax upon corporations has been lower than the average for the United States as a whole.

The evidence shows that our revenue system is out of balance. Nor will the enforcement of the present laws, as some advocate, bring it into balance. Even if it were possible to assess stocks, bonds, and mortgages, there would be no justice in so doing since they are in reality not property but mere evidences of contract or claims to property. In the past it has been difficult to abandon such taxes because it would mean that jurisdictions of residence might thereby relinquish the possibility of tax collection from many individuals. The development of income taxes, however, alleviates such a difficulty. The income tax has taken the form of taxes upon personal incomes, corporation incomes, and at present there seems to be some tendency to include all business incomes. Since Wisconsin adopted the income tax in 1911 about one-half of the states have included it in their system of taxation.

The inherent justice in income as a tax base is evident—whatever the base upon which a tax is levied, it can only continue to be paid from income. Whether individual or business, a tax upon income suggests the fairest method of levy. Business, however, counters that to do such would crush it or drive it from the state. Evidence from the state of Wisconsin indicates that the adoption of a tax upon business income has been no deterrent to business and one wonders to what state Illinois business would migrate since taxes in neighboring states are considerably higher. The fact is, that by leaving with the farmer and small income group funds which would have been taken in taxes, business has been stimulated and incomes have accrued out of which taxes can be paid.

It is the intention that the adoption of an income tax will relieve other overburdened sources of revenue, especially property. It may do this by the state giving up property as a source of revenue or may go further and take over some of the functions formerly performed by smaller units. The latter is desirable only if the state can perform them as efficiently and economically. The state, moreover, may allocate a part of the collected receipts to localities. Here care must be used to choose a satisfactory basis of distribution. The plan used in New York, assessed valuation of real

estate, has much to commend it. In the consideration of an income tax, moreover, care should be given to the real consequences which may come from any offset provisions.

A balanced revenue system will attempt to secure the funds necessary to perform the functions properly allocated to government so that they will come from those who are able to pay, from sources the administrative obstacles of which are not insurmountable, and that will produce a reasonably steady revenue at moderate cost. A system built around income taxes best meets these criteria. It does not, however, exclude other tax bases. Real estate may still be taxed locally; death duties fit the criteria of justice and productivity; and as a source for construction and maintenance of highways no more justifiable base can be found than the gasoline tax.

Suggestions for possible new sources of revenue come from the stock transfer tax of New York and the grain futures tax of the Federal government. The latter, especially, could be made very productive with a comparatively low rate.

The total tax burden in Illinois is not heavy, either as a per capita charge or as a percentage of social income. The difficulty has been that the revenue system has not been balanced among the groups that are most able to pay. It is to this problem that attention needs to be given.

PAPERS IN GEOGRAPHY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

Five of the six papers on the Geography program were presented at the section meeting. The following was read by title only and was not presented for publication:

"The Osage orange: a transitional geographic factor in central Illinois," by Robert G. Buzzard, Illinois State Normal University, Normal, Illinois.

The following papers were withdrawn from publication when abstracts were requested to replace the full length manuscripts:

"The extension of the wheat belt in western Canada," by F. C. Bohannon, Galesburg High School, Galesburg.

"The agricultural pattern of East Lothian," by G. Donald Hudson, University of Chicago, Chicago.

The average attendance at the meeting was forty-five and the maximum was fifty-one.

Miss Ruby Harris, Teachers College, Charleston, Illinois, was elected chairman of the Geography Section for 1932-1933.

(Signed) MABEL CROMPTON, *Chairman*

BLOOMINGTON: AN URBAN COMMUNITY

BY

EDNA M. GUEFFROY

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SETTLEMENT AND GROWTH OF POPULATION

To the earliest permanent settlement, the prairie was an enemy. Hence the most suitable regions for settlement, and those which were actually first taken into possession in central Illinois, lay chiefly along the groves where they border on the open prairie. The advantages of a grove location, together with a focus of trails drawing men together, offered a site for the present city of Bloomington.

The idea of establishing a town apparently originated with a young farmer who came here in 1829 in search of good farm land. The following year he donated 22½ acres of land on the north edge of Blooming Grove settlement to be used as the cite for the county seat of McLean County. He saw that the north and south line of travel between the Galena lead mines and the settled parts of southern Illinois crossed the main east and west emigrant road between the French trading posts on Wabash River and Peoria, near Blooming Grove. The trail from Lake Michigan to St. Louis was also in the vicinity, and the young farmer foresaw that lines of stage and emigrant travel could easily be induced to pass through this point. It is interesting to note that three lines of railway and parallel roads of concrete follow these old lines of travel, and all cross at Bloomington.

Although founded in 1830, the settlement was not incorporated as a village until 1843. By that date the population numbered approximately 800. Reports of the fine agricultural land and opportunities for trade drifted back to the older settlements to the east and south and soon newcomers began to arrive to make their homes and set up small businesses. With the extension of the Illinois Central and Alton railroads into McLean County in the early fifties and the campaign for improved dirt roads and bridges, population increased rapidly, until in 1860 it was 8000, an increase of 343.9 per cent over that of 1850. The beginning of the industrial development in Bloomington in 1867, with the establishment of the Alton Railroad shops, brought a decided increase and in 1870 the population was 13,000. From 1880 until 1920 the increase has been comparatively steady. The census of 1930 shows a population of 30,883. The small gain of 7.7 per cent since 1920 is explained in part by the suspension of work at the coal mine, once one of the leading industries of the city, the loss of several minor industries, and the reduced forces of the Alton Railroad shops.

COMMERCIAL AND INDUSTRIAL AREAS

The commercial core of the city, which has for its purpose the service of the urban community and approximately one hundred surrounding towns and villages, is centered around the County Court House. It is characterized by buildings three and four stories in height. The expansion of the retail district has been most pronounced along a north-south axis, following the earliest paved highways which assist merchants materially by permitting the operation of both freight and passenger motor lines.

Situated in the heart of a rich argicultural region, Bloomington is primarily a distributing center rather than a manufacturing center. However a review of the list of industrial establishments reveals a total of ap-

proximately fifty factories. Their nature testifies to the fact that the manufacturing interests of the city are diversified, no special line being carried on to the exclusion of others. This may be further explained by the fact that the early settlers had to depend largely upon their own efforts for the utensils with which they conducted their household, farming, and mercantile management. There were no railroads; the rivers were not direct and were a slow means of transportation; the country roads were usually in poor condition and for months at a time were almost impassable.

The present manufacturing interests are centered largely in the repair and machine shops of the Alton Railroad. Chiefly because of the accessibility to direct railroad connections and cheap land, the heavy industries of the city are located in small areas close to the railroad yards. Three foundry and furnace companies manufacture stoves, hot air furnaces, and special heating and ventilating apparatus for public buildings. Electric washing machines, farm scales, grain elevators and iron castings are made by the Meadows Manufacturing Company. The latest enterprise of importance is the Williams Oil-O-Matic Heating Corporation, manufacturers of oil burners.

THE RESIDENCE DISTRICTS

Of the total area of Bloomington, approximately 75 per cent is occupied by residences. In general the new superior class of residences with their large lots and nicely landscaped gardens occupy the east side of town where there is relative seclusion from industrial and commercial areas, and where the views are more pleasing. Many of the old homes of frame and brick construction, the mansions of yesterday, have been converted into apartment houses, fraternity and sorority houses, and funeral homes. Along the western fringe of the city in the neighborhood of the abandoned mine and railroad yards are the poor residence districts, chiefly occupied by negroes and foreigners who make up about 13 per cent of the total population.

Beyond the corporation limit, attracted by the cheaper land outside and by the lower taxes beyond the city limits, are residences similar to the ordinary type of residence within the city limits. Excepting for the inclusion of vacant land in the southeast, Bloomington is relatively compact, the few vacant areas within the main body of the city being made up of undesirable land close to the railroads.

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1. Burnham, J. H., Bloomington, McLean County, Illinois: Its situation; Its Advantages. Published by the Bloomington Club. 1890.
2. Hasbrouck, J. L., History of McLean County. Vol. 1.

COFFEE PLANTATION ITEMS IN THE BRAZILIAN PATTERN OF TERRENE OCCUPANCE

BY

ROBERT S. PLATT

University of Chicago, Chicago, Illinois

ABSTRACT

The coffee region of São Paulo occupies about one per cent of the area of Brazil. Its form reflects the advance of a frontier. Coffee growing began on the coastal lowlands, then leapt a mountain barrier into the Parahyba Valley, and a second barrier into the plateau region of rolling uplands. There coffee spread northward and westward, along railway lines as they advanced, expanding in favorable areas of fertile land. Toward the north it has practically reached the limit of good land; toward the west it is still advancing.

Details of the pattern of terrene occupance in this region are illustrated by reconnaissance studies of plantations at the old threshold of the plateau region in the Campinas district and on the new frontier in the Marilia district.

The Fazenda Chapadão in the Campinas district is eighty years old. The property has an area of about four thousand acres and occupies approximately the basin of a small stream. Six hundred acres are occupied by coffee, on ridge tops and upper slopes around the head waters of the stream. Lower slopes and bottom lands, generally less well drained and more subject to frost than the ridges, afford space for supply crops, pasture, wood, and the central buildings of the plantation.

The coffee is grown without shade in the Brazilian manner, suitable under conditions of expanding settlement on virgin land. Now that Chapadão is an old plantation some shade might be beneficial, as suggested by the dead tops of many old coffee plants.

The whole crop is harvested at one time by stripping the plants, a Brazilian practice responsible in large part for low cost of production and low value of product. The quality of Chapadão coffee is slightly above the average by reason of a well equipped cleaning plant using the wet method, which improves average quality by sorting out unripe berries.

In competition with new lands on the coffee frontier, Chapadão is handicapped by old plants, soil depletion and insect pests. Diversification of crops is under consideration. The chief supply crops grown by the laborers in their allotted fields are corn, beans, and bananas, none of them suitable for export. However, the district has advantages for commercial production of other fruits and experimentation is under way. Oranges have been shipped to Argentina for an early season market and to Europe for an off-season market, but it is unlikely that fruit will supersede coffee in this older part of the region.

Marilia on the frontier is at the end of one of the railways advancing to the west. Fazenda Miranda, a few miles northwest of the town, is in the midst of virgin forest. The original property had an area of 150,000 acres, but most of this was subdivided for sale and only about one thousand acres reserved for the owner's plantation. The owner is a non-resident and the plantation is operated by a manager, as is Chapadão.

The form of the plantation is like that of Chapadão, occupying the basin of a small stream. Two hundred fifty acres are occupied by coffee, on ridge tops and upper slopes. Part of the lower land is in pasture, but none in separate fields of supply crops, the laborers as yet growing their supplies between rows of coffee.

Each year a tract of forest gives way to coffee. The trees are felled at the beginning of the drier season and left to dry. Then at the end of the season the brush is burned and coffee seeds are planted.

Some of the plantations of the district are different in certain ways. The Fazenda Pollan has an area of only one hundred twenty-five acres, and the owner is an Italian immigrant who lives and works on the plantation. Like others, the property occupies the head of a small drainage basin, in which are eighty acres of coffee on the surrounding ridge land. With the young coffee there is interplanting of supply crops and of some temporary money crops, particularly tobacco and rice.

In the town of Marilia, founded as the center of a coffee district, the leading establishments at the start are rice cleaning plants and lumber mills. These aspects of the frontier are temporary and plans have assumed that the frontier itself is temporary. The organization of the coffee industry has been developed on advancement into new land. The area thus far occupied is only five per cent of the state of São Paulo, and there is much more land available for this crop, which has such narrowly specific requirements that few regions of the world can produce it. But little land is required to satisfy the world market; consumption appears to limit the industry. Perhaps the era of expansion is at an end.

Papers In Geology

Extract From the Report of the Section Chairman

All but two of the thirteen papers on the Geology Section program were presented at the section meeting, and all but one of those presented are published herein.

"The nature and origin of fusain," by C. H. Crickmay of the University of Illinois is not included.

Those which were read by title only and were not presented for publication are as follows:

"Micro-fauna of the shale parting in the LaSalle limestone," by H. L. Geis, University of Illinois.

"Loess deposits related to Wisconsin glaciation," by Morris M. Leighton, Illinois State Geological Survey, Urbana.

Maximum attendance at the section meeting was sixty.

Mr. J. E. Lamar, Illinois State Geological Survey, Urbana, was elected chairman for 1932-1933.

(Signed) T. E. Savage, *Chairman*

MICROFAUNAL TECHNIQUE IN THE STUDY OF OLDER PALEOZOICS

BY

PAUL H. DUNN

University of Chicago, Chicago, Illinois

The correlation of older Paleozoic rocks has been found in many cases to be difficult on account of the scarcity of fossils. This may be due to the fact that conditions were antagonistic to life during the deposition of the sediments or at least to the preservation of fossils, or it may be due to changes which have taken place in the rock since deposition. Since it has been found to be a somewhat general rule that the more ancient rocks are the most altered, it is not surprising that the older Paleozoics in some areas are essentially devoid of fossils.

The term "non-fossiliferous," however, has been applied in too many cases to those rocks having no megascopic fossils, and the possibility of the presence of microscopic forms in many such rocks has been overlooked. Furthermore the microfauna of a limestone is likely to be destroyed in any alteration process unless some unusual character prevents it. Were we to look for animals with such an unusual character, the arenaceous foraminifera would seem to offer the most promising possibilities. These animals have tests composed of cemented sand grains or other foreign objects, and, no matter what the cementing material was originally, it is found to have been silicified in most cases or at least altered to such an extent that the tests are now more difficult to break down than the surrounding rock matrix.

A technique for breaking down both altered and unaltered rocks without also destroying these foraminifera is now needed. This paper discusses only those processes by which limestones have been broken down. The limestones examined ranged from high-calcium types to those which were true dolomites. Since even a small amount of effervescence will destroy the more fragile foraminifera, the greatest care must be taken with all types of limestones to prevent the destruction of these forms. The presence of broken down tests can be detected by fragments in the pan after screening.

The most important step in the process, then, is the determination of the correct strength of acid to be used for the given type of limestone. When there is only a small sample to work with even one mistake may destroy all available material. A safe method is to place the sample, which has been thoroughly washed, in a beaker or large tumbler and add water until the container is three-fourths full. There should be at least ten times as much water as the space occupied by the sample and even a greater proportion of water is desirable. Hydrochloric acid is added very slowly. The C. P. grade has been found to give much better results since the commercial grade will often cause a harmful precipitate of gypsum. A strength of forty parts water to one part acid is, in many cases sufficient. After adding a small amount of acid it is best to wait a few minutes until the temperature of the solution rises, since this rise in temperature aids in the breaking down process and must be taken into consideration.

If the sample that is being examined is limited in amount, greatest care must be used to prevent the destruction of the specimens that have been freed from the matrix. When raw acid is poured into the beaker it

sinks to the bottom and the unprotected specimens are bathed with strong acid which in most cases is strong enough to break them down. This necessitates washing the residue after the action of the acid has ceased and before any fresh acid is added. The part of the sample that has not been reduced is carefully lifted out. If it is to be further reduced, it may be placed in a second beaker and the surplus liquid poured onto it. The residue is then carefully washed into an evaporating dish. The strong current from a faucet should not be allowed to strike the residue. A slow process of washing and decanting should be employed until the water is perfectly clear. All the water is poured off with the exception of a sufficient amount to wash out the residue onto a square of paper. Ordinary newspaper has been found to give better results in this drying process than a harder or rougher paper. The wet residue will stick to the newspaper and the surplus water can then be poured off. If the paper is too rough, as is the case, for example, with paper toweling, the dry residue cannot be removed without breaking the specimens.

A convenient method of drying indoors is over a radiator. A table just high enough to stand above the radiator is placed over it, and the part of the table directly over the radiator is replaced with wire screen. A number of papers may be placed on this screen and dried as slowly as desired. A portable electric heater also may be used successfully in this process. Drying over a fire is dangerous, for, if the water in the foraminifera is heated it will soon destroy them.

Residues from very weak acid solutions will often also contain silicified and chitinous fossils such as ostracods, sponge spicules, small corals and brachiopods, conodonts, scolecodonts, and many other forms that should be of interest to paleontologist and stratigrapher.

Since the method followed here destroys the calcareous microfauna in the limestone, it is probable that in many cases the faunal lists would be greatly increased by the development of a technique for the study of the calcareous forms. Although thin sections have not shown the presence of calcareous foraminifera, they have shown that other calcareous forms are very abundant in some samples.

The finding of an abundant foraminiferal fauna in the Silurian rocks of the Mississippi Basin certainly indicates that an important method of correlation has long been overlooked, and that now an entirely new field of study is opened to the geologist who is interested in the correlation of the older Paleozoics.

SOME PROBLEMS OF ENGINEERING GEOLOGY IN THE VICINITY OF CHICAGO*

BY

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ABSTRACT

Most of the problems in engineering geology encountered in the vicinity of Chicago are consequent upon (1) the character and succession of the glacial and interglacial deposits, (2) the character and succession of materials deposited by glacial Lake Chicago, or (3) the topographic expression of the deposits.

Gravel, sand, silt, muck, and peat may occur irregularly between till-sheets and with each till may be gravel, sand, and silt. The bedrock surface on which the drift lies is irregular, cropping out at some places and elsewhere being buried as much as 300 feet. The deposits of Lake Chicago are very inconsistent; they lie on an irregular surface of glacial drift and include deposits of peat and muck. Although considerable data on these conditions have been accumulated they are not yet sufficient.

Progressively more elaborate procedure to assure foundations sufficiently firm and stable to support the skyscraper structures in Chicago involved first, the deepening of excavations for footings, second, the use of piles, and third, the construction of caissons, all of which practices encountered difficulties consequent upon the geologic situation. Excavations for sewers, water and gas mains, conduits, subways, and other utilities encounter problems not only of geology but also of urban restrictions. Some test-pits and test-borings have already been made for the proposed subways and more will be made to determine just what geological conditions will be encountered along the proposed routes.

Most of the other problems of engineering geology in the vicinity of Chicago relate to paved highways and may be classified as (1) selection of the most favorable route, (2) selection of material for fills and pavements, (3) location and type of grade-separation, (4) location and construction of bridges, (5) location and construction of subways, (6) irregular heaving of pavements, (7) face-slump and sod-creep on cuts, and (8) bogs.

In northeastern Illinois the highways should be routed so that they cross no bogs, parallel no slopes, and require no cuts more than a few feet deep. For fill material, firm clayey till or gravel is most desirable; sand may be used, but it requires a broad base; silt, silty till, and similar material should be avoided.

The abundance of gravel and limestone in the Chicago area leaves little to be desired for pavement material although in some gravel there is too much shale, chert, or other deleterious substances and some limestone includes too much chert and other types are too argillaceous to be satisfactory. The locations of grade-separations are nearly fixed, but local conditions may determine whether an underpass or an overpass is most practical.

Generally the location of a bridge is determined by other factors, but in a few instances the topographic and geologic conditions control, to a greater

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degree they influence the type of construction, and they are certainly the prime consideration in determining the location, depth, and size of the supporting piers and abutments.

The variety and succession of glacial drift in the Chicago region has caused some instances of irregular heaving of pavements during freezing weather, due to the fact that the material in the subgrade is so porous that water seeps through it or is adsorbed by it. Some of the glacial drift in the Chicago region is silty or sandy and so loosely compacted that it tends to slump and flow whenever saturated by water. The logical consequences along highway cuts can be easily conceived, but fortunately they can be largely prevented by emplacement of drains at critical locations.

Many of the depressions which are characteristic of glacial deposition in northeastern Illinois are now occupied by bogs in which the usual sequence of materials is a superficial layer of matted peat, then a layer of marl, and then muck to the bottom, but in some there is sand and silt and in others there is a complex succession. Construction of highways and highway fills across bogs without regard to their character and material content has commonly resulted in serious trouble and disaster, so that engineers prefer to route a highway around a bog if possible. At numerous places not only have the highways across bogs sunk almost below water-level but also the culverts under them have entirely disappeared.

In order to obtain exact knowledge concerning conditions in bogs, the need for test-borings, accurate samples of materials, and accurate location of different strata before, during, and after construction of fills is becoming better recognized. At present, explosives are used (1) to break up the surficial peat-mat and (2) to assure displacement of muck from beneath a fill and to hasten settlement of the fill. This is satisfactory for deep bogs, but for shallow bogs it seems more practical to remove the unstable material by some mechanical means and then replace it with stable material. Care must be exercised that a fill across a bog does not become a dam. In a few instances they have been purposely planned as such but otherwise passages through the fill must be provided. One of the most interesting problems in connection with peat-bogs is their utilization for parks and playgrounds.

THE QUESTION OF THE SHOAL CREEK AND CARLINVILLE LIMESTONES*

BY

SIDNEY E. EKBLAW

Assistant Geologist, on Detail from The State Geological Survey to the State Water Survey

INTRODUCTION

A Pennsylvanian limestone which crops out extensively along Shoal Creek was first designated as the Shoal Creek limestone by Engleman[1] in his report on Washington and Clinton counties in 1868. This limestone as exposed in outcrops about two miles southwest of Carlyle in Clinton County and again at Carlinville in Macoupin County had been previously correlated with the Curlew limestone of Kentucky by Professor Leo

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[1] Engelmann, Henry, Geology of Washington County and Clinton County, Geological Survey of Illinois, vol. III, pp. 148, 159-164, 175, 177-183, 1868.

Lesquereux in 1860[2], but in 1907 Udden[3] pointed out that this correlation was erroneous, believing this particular limestone to be the equivalent of the Carthage limestone of Kentucky. Worthen in his report on Macoupin County in 1873[4] called this limestone the Carlinville limestone because of its outcrops at several points in the vicinity of Carlinville.

Broadhead referred to it as the Shoal Creek limestone in his report on Bond County in 1875[5]. Udden and Shaw followed this terminology in their report on the Belleville-Breese quadrangles in 1915[6] and Shaw followed it again in his report on the Carlyle-Centralia quadrangles in 1923[7]. In his report on the Gillespie-Mt. Olive quadrangles in 1926, Lee[8] noted the occurrence of two limestones — the upper he correlated with the Shoal Creek and the lower he designated as the Carlinville limestone because of its exposures near the town of that name, thus repeating Worthen's nomenclature.

RECENT STUDIES

Reconnaissance investigations in the southwestern part of Illinois during the summer of 1931 disclosed the following composite stratigraphic section between two major Pennsylvanian limestones in Macoupin and Montgomery counties:

	Thickness Feet	Inches
LaSalle (?) cylothem		
LaSalle (?) limestone		
Limestone, fossiliferous, hard, gray, with nodules of darker limestone		10-18
Limestone, very fine-grained, gray; weathers gray to pink and becomes slabby on exposure	4	6
Clay, calcareous, gray tinged with green, contains microfauna		5
Limestone, fossiliferous, light gray, also tinged with blue, more regularly bedded than that above	2	2
Clay, calcareous, yellow		5
Limestone, fossiliferous, very fine grained, very hard, gray speckled with blue		9
Shale, calcareous, gray to gray tinged with green, poorly bedded	2	2
Shale, black, hard, thin-bedded		5
Shale, dark gray tinged with green, poorly bedded		7
Shale, black, hard, platy, fossiliferous		5
Shale, olive gray, light to dark, with a 2-inch band of dark limestone concretions 6 inches above the base	2	8
Shale, gray, fossiliferous, with gray fossiliferous bands of limestone up to ½ inch thick	2	
Shale, gray, tinged with green and dark gray	1+	
Clay, calcareous, light gray to olive, ctontains small calcareous concretions	3	4

[2] Lesquereux, Prof. Leo, Report on the Coal Fields of Illinois: Geol. Survey of Illinois, vol. I, pp. 222, 227, 1866.

[3] Udden, J. A., Notes on the Shoal Creek Limestone: Ill. State Geol. Survey, Bull. No. 8, p. 119, 1907.

[4] Worthen, A. H., Geology of Macoupin County: Geol. Survey of Illinois, vol. V, p. 290, 1873.

[5] Broadhead, G. C., Geology of Bond County: Geol. Survey of Illinois, vol. VI, pp. 129, 131-134, 1875.

[6] Udden, J. A., and Shaw, E. W., Description of the Belleville and Breese Quadrangles: Geologic Atlas of the U. S. No. 195, p. 6, 1915.

[7] Shaw, E. W., Description of the Carlyle and Centralia Quadrangles: Geologic Atlas of the U. S., No. 216, p. 5, 1923.

[8] Lee, Wallace, Description of the Gillespie and Mt. Olive Quadrangles: Geologic Atlas of the U. S., No. 220, p. 5, 1926.

Shale, sandy, calcareous, with beds of calcareous sandstone having trails of invertebrates	7	2
Macoupin cyclothem		
Limestone, silty, light gray tinged with blue		6
Shale, silty, olive gray, with calcareous concretions	4	
Limestone, gray tinged with blue, crinoidal, with some thin lenses of calcareous shale	2	6
Shale, calcareous, gray tinged with green, fossiliferous		11
Shale, dark gray	1	2
Shale, black, hard, platy, fossiliferous	2	9
Coal (No. 9 of Worthen section)		8
Clay, gray	4	8
Shale, calcareous, olive	1	
Sandstone, calcareous, buff with sandy shales and limestones, carrying mudcracks, marine fossils, ripple marks and trails	6	
Centralia cyclothem		
Limestone, gray spotted blue, fossiliferous	3	
Shoal Creek cyclothem		
Shale, sandy, partly calcareous, gray to olive	0-14	
Shoal Creek Limestone		
Limestone, gray, fine-grained, compact, fossiliferous; fractures into rectangular blocks	6+	
Clay, calcareous, olive		3
Limestone, gray tinged with brown, compact, fossiliferous, massive	1	8
Clay, calcareous, olive, soft		5
Shale, olive, noncalcareous, sandy		10
Shale, black, hard, platy		9
Shale, coaly (coal at some localities)		2±
Clay, silty, noncalcareous in upper part, light gray	2	4
Sandstone, calcareous, buff to gray	10+	

This succession varies somewhat as it continues to the south through Bond, Clinton, Washington, Jefferson, and Marion counties, especially in regard to the upper limestone horizon which is represented in Jefferson and Marion counties by a massive calcareous sandstone, the lower portion of which is fossiliferous.

The lower limestone crops out extensively along Shoal Creek in Bond and Clinton counties and is therefore unquestionably the one originally named Shoal Creek. As the described section was traced northward it was discovered that Worthen's local Carlinville limestone was identical with the Shoal Creek limestone and that Lee's correlation was erroneous in that he applied the name Carlinville to the lower limestone and the name Shoal Creek to the upper limestone which actually lies about 50 feet above the true Shoal Creek limestone.

CONCLUSION

Consequently it becomes necessary to correct Worthen's and Lee's terminology and correlation by applying the name Shoal Creek to the lower limestone. Inasmuch as confusion would arise by attempting now to apply the name Carlinville to the upper limestone, it seems eminently desirable to abandon the name Carlinville. Further as the upper limestone appears to occupy the same stratigraphic position as the LaSalle limestone, it seems that the name *LaSalle* may well be applied to it.

WATER SUPPLIES IN LAKE COUNTY, ILLINOIS

BY

W. D. GERBER

Engineer, Illinois State Water Survey, Urbana, Illinois

ABSTRACT

Water supplies in Lake County are obtained from two general sources, lakes and wells. Lake Michigan, with a hardness of about 130 p.p.m., furnishes raw water for the cities of Waukegan, Lake Forest, Highland Park, the Great Lakes Naval Station and the Army Post at Fort Sheridan. At each of these communities the raw water is filtered and sterilized before distribution to the consumer.

The communities of Highwood and Deerfield purchase filtered water from Highland Park, but all other municipalities, except those above named, depend upon wells for their supply.

Well waters may be divided into four groups, each named from the source of the water supply.

Sand and gravel well waters.—The bedrock is covered with a mantle of drift that ranges in thickness from 90 feet at or near the lake shore to 300 feet or more in the west part of the county. Much of this drift is comprised of sand and gravel deposits, particularly in the west half or lake region of the County, and it is in this general area and in the buried valleys developed in the limestone bedrock that the sand and gravel well is most efficient as a source of ground water supply.

In the main, water from sand and gravel is considerably harder than that from Lake Michigan. The minimum and maximum extremes found from analyses were 53 p.p.m. and 977 p.p.m., respectively. The softer waters are found in the northeasterly portion of the county with a progressive increase in hardness to the south and west. Most gravel well waters contain some iron though in many instances not in sufficient amounts to cause staining. Sulfur odor and taste were found in but a few wells, notably in the vicinity of Half Day.

Limestone well waters.—The limestone well as a water supply is more prevalent in the eastern half of the county than in the western. The study and comparison of the logs of wells into this formation developed three notable valleys filled with sand and gravel from which copious supplies of water are being obtained.

From the many analyses of limestone well waters it was observed that the hardness varied from 7 p.p.m. to 865 p.p.m. In general, it may be said that waters having a hardness of 100 p.p.m., or less, may be found in Benton, Newport, and Antioch, the north half of Lake Villa, the north third of Warren, and the north half of Waukegan townships. A progressive increase in hardness is found to the south and west.

A majority of the waters analyzed contained iron, some having highly objectionable amounts. Some of the low hardness waters were high in sodium salts which imparted a marked flavor to the water.

Many wells into the limestone yield a water strong in sulfuretted hydrogen, and some 30 wells yield gas and small particles of oil. This latter material, of course, makes the water objectionable for domestic use.

St. Peter sandstone wells.—Of the 59 deep wells studied, 29 are classified as St. Peter sandstone wells since the water from them is drawn from the St. Peter sandstone.

The hardness of these waters varies from 200 p.p.m. to 450 p.p.m. Here again the distribution of hardness is similar to the waters previously discussed, that is, the softer waters being noted in the northeasterly portion of the county, with an increase in hardness to the south and west.

Most of the St. Peter well waters contain iron, about a third of the total having a concentration to an objectionable degree. As a rule, the St. Peter sandstone waters do not contain H_2S, though several that did were found. Oil and gas are not generally associated with the St. Peter sandstone water.

The yield from this sandstone has diminished to a point where 75 p.p.m. is generally considered a good one.

Cambrian system wells.—There are two sandstones embraced under this general title: the upper is called the Dresbach sandstone and the lower the Mt. Simon sandstone.

These aquifers generally have high yields, particularly the Mt. Simon, since they have not been drawn upon as long or as hard as some others.

The hardness of the Dresbach sandstone water has an average of about 250 p.p.m. while that of the Mt. Simon sandstone is 335 p.p.m. Heavy pumping frequently has produced an increase in mineral content and hardness.

Many of the deep well waters contained iron, but it was difficult to determine whether this mineral came from the aquifer, or from the metal parts of the pumping equipment. Of the 30 deep wells studied, 16 contained H_2S, while only one indicated gas. It is likely that the H_2S and gas may come from uncased portions of the top limestone.

PLANT RESIDUES OF COAL NO. 6*

BY

ORRIN J. HENBEST

Illinois State Geological Survey, Urbana

INTRODUCTION

The materials herein described are the products of maceration of a column of No. 6 coal. A modified process of Franz Schulze's method (1855) as described by McCabe[1] in 1931 was used to prepare the coal for study. The crushed coal was oxidized for four days in a concentrated solution of nitric acid and potassium chlorate and then washed, first in ammonium hydroxide to remove the brown humic matter and then in water. The residue contains various easily isolated plant fragments such as spores, epidermis, cuticle, carbonized wood fragments, resin, etc. The desired structures are removed with a small pipette and mounted in glycerine jelly, which gives clear definition in a photo-micrograph. The plant residues may be seen to best advantage in water by placing them under a binocular microscope and using a combination of reflected and transmitted light. Photography of the material in water is difficult however.

The column of coal was ½ x 1 x 76¾ inches, and was cut parallel to the bedding plane in 2 centimeter sections. The average volume of each

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[1] McCabe, Louis C., Some plant structures of coal: Trans. Illinois State Acad. Sci., vol. 24, p. 321, 1931.

section macerated was 5 to 6 cubic centimeters. The different bands varied considerably in their response to the treatment of the macerating fluid; practically all of the vitrain[2] or vitreous coal and about half of the clarain[2], which contained most of the spores and epidermis, went into solution, but only a negligible amount of the fusain was soluble.

SPORES

Spores are among the best preserved and most interesting plant residues found. They resemble in structure the pollen grains of some members of the present pine family or the spores of living ferns. Most of them are very translucent, some being almost transparent. In reflected light they have a bronze luster, and in transmitted light the color is reddish brown.

Several kinds of spores occur: (1) spores of homosporous plants, those that bore only one kind of spores, which upon germination gave rise to a new generation in the life history of the plant; (2) spores of heterosporous plants, plants that bore two kinds of spores (microspores and megaspores) as Lepidodendron or the modern Selaginella; and (3) the microspores or pollen grains of the seed plants.

The spores range in length from 1/40 mm. to 2.9 mm. The general shape is circular to oval. Some of them have bladder-like wings, some have a marginal wing, and still others have no appendages. The bladder-like wings give some of the small spores the appearance of modern pine pollen grains except for their larger size, .3 mm. including the wings. The common winged spore is about .6 mm. in diameter and the marginal wing averages .1 mm. in width. This spore also shows a feature characteristic of many of them, namely, a triradiate mark, ridge, or slit which represents the angle of contact between the spores of a tetrad or group of four spores that resulted from two successive cell divisions of the spore mother cell in the sporangium. Each mature cell was capable of reproducing a new generation in the life history of the plant. Each spore in the tetrad is about .6 mm. in diameter and has a peculiarly marked surface. On the surface opposite the triradiate mark is a design that resembles the facets in the compound eye of an insect. Most of the spores have thin membranous walls without any markings or appendages.

Some of the sections of coal contained many small spores which were about 1/40 mm. in diameter, but the great percentage of the spores ranged from .4 mm. to .7 mm. in diameter. Two of the 98 sections in the column of coal contained no spores, four contained less than half a dozen spores, but many of them contained more than 100 spores.

EPIDERMIS

Epidermis is the layer of cells on either side of a leaf or on the outside of a young stem, whereas cuticle is the protective layer of non-cellular waxy material deposited outside of the epidermis. These structures may prove to be of value in identifying the species of the coal-forming plants. Well preserved epidermis is not abundant in the residues, but the outlines of the cells are common on the many fragments of cuticle which make up a large part of the material. Some specimens of cuticle have well preserved cells as shown by the presence of stomata and by the spines or epidermal hairs.

The more common type of epidermis preserved is well distributed in the column. The asymmetrical cells are usually irregularly arranged except for two or three rows which follow the line of a vein. The individual cells average .1 mm. across. A small thick piece of epidermis with narrow cells averaging about 1 mm. in length was isolated; the stomata

[2] Stopes, M. C. Proc. Royal Soc., vol. 90, series B, pp. 470-487, 1919.

have no regular arrangement. An unusual fragment containing epidermal hairs, stomata, and cells of two shapes was also found. The epidermal hairs, .2 mm. long, are borne in areas of more or less elongate cells with no stomata. On either side of this area are areas of irregular cells and stomata which are spaced from .05 to .1 mm. apart.

WOOD AND OTHER STRUCTURES

The most prominent characteristic of wood cells in both modern and fossil plants is the pitting in the cell walls. The "pits", which formed during the thickening of the walls, represent areas of very thin membrane which provided for communication between adjacent cells. They are variously shaped, some circular and some elongate.

Some of the pitting in the wood cells is remarkably preserved. Each row of scalariform or ladderlike pits represents one side of a cell wall. The pits, the longer of which may be .07 mm. in length, average about 85 to the mm. Some carbonized wood fragments exhibit a striking resemblance to the vascular strands that may be seen at the node of a cast of Calamites. The small piece measures .6 mm. from left to right. One piece shows four spiral vessels. The spirals represent thickened walls inside the vessels.

Other interesting structures found were a seed?, sporangia, periderm tissue, cross-sections of thickened wood cells, and resin rodlets and globules.

THE LITHOLOGY OF COAL NO. 6*

BY

LOUIS C. MCCABE

Illinois State Geological Survey, Urbana, Illinois

The most striking characteristic of the coals of the Illinois basin is their banded appearance. A megascopic analysis of twenty-one columns of coal No. 6, each of which represents the entire seam and which average 6 feet 8 inches in length, shows an average composition of 75.88 per cent clarain[1] (glossy), 13.83 per cent vitrain[2] (vitreous), 5.58 per cent fusain ("mineral charcoal"), 2.56 per cent clay, and 2.15 per cent pyrite.

The vitrain bands, which vary in thickness from a maximum of 5½ cm. to an arbitrary lower limit of ½ mm. (for practical measurement), are uniform and sharply defined. These bands are brilliant in appearance and usually show conchoidal fracture although cubical structure is sometimes induced by minute vertical fractures within the band. Vitrain continues for some distance through the bed although its lenticular nature can be demonstrated. Commonly the bands are in pairs which rarely can be traced along the bed until they merge and terminate. A thin section through such bands show them to be opposite walls of a cylinder in which the poorly organized central tissue has collapsed.

Vitrain may exhibit a number of forms in thin section depending upon (1) the direction in which the cylinder is oriented with relation to the plane of the cut—single, double, continuous, or lenticular bands are possible; (2) the anatomy of the plant, whether a pithy, hollow, or solid cylinder; (3) the presence of branches at the point sectioned; (4) the stage of growth at the time of preservation—a young succulent stem would find

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[1] Stopes, M. C. Proc. Royal Soc., vol. 90, series B, pp. 470-487, 1919.

[2] Evans, M. M., Slater, L., and Wheeler, R. V., On Vitrain: Fuel, Vol. VIII, pp. 30-36, 1929.

expression as a single band; and (5) the state of preservation of the material—some trees were undoubtedly split in falling or were partially decayed before burial.

Cell structure is most readily seen in a well prepared cross-section of a stem because the cell walls in such a section exhibit a greater contrast to the material filling the lumens than they do in radial or tangential section. A single vitrain band sometimes shows two zones of well preserved cells in the position of the secondary cortex on either side of the cylinder. The cells in vitrain are but little distorted when filled with infiltered material. The inference that the filling was largely of secondary origin follows from the fact that the protoplasm in actively growing cells is not capable of filling the lumens when it has suffered extreme dessication and from the fact that in the living plant the cells of older tissues are void of protoplasm or it is of negligible quantity. Occasionally thickened cells in the vitrain are not filled and many such cells have collapsed. This *bogenstruktur* frequently passes into fusain which it resembles except for its translucency.

Clarain, the most heterogeneous of the banded constituents is markedly striped and glossy in appearance. It is closely knit but does not maintain the uniform thickness and definition so characteristic of vitrain. Thin sections show it to be composed of spore exines, cuticles, resins, and the degradation products of plants. In it are enclosed vitrain bands of megascopic and microscopic dimensions.

Resins in the form of rodlets or globules and in zones three to four millimeters wide are common in both the clarain and the vitrain. Such zones are made up chiefly of many small ellipsoidal wine-red bodies, although a pale yellow variety rarely occurs.

Fusain is present as dull black powdery or shiny lenses, fragments, or bands. It is flattened and striated parallel to the bedding, the striated appearance being due to the fibrous nature of the original wood, resin rodlets, or both. The fragments and lenses are distributed through the clarain as microscopic groups of thick-walled xylem cells. The cells are not filled with humic material but a secondary filling of mineral matter may be present[3].

Fusain is sometimes associated with vitrain; in such instances it represents the outer cortex of the plant and the vitrain the enclosed tissues of the cylinder. A radial section of a Calamites stem from the Kathleen mine at Dowell, Jackson County, shows fusain forming the cortex and passing progressively inward to vitrain in which the pitting of the cell walls may be faintly seen. The fusainized cortex of Lepidodendron and Stigmaria have been found to extend for some distance along partings in the bed.

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[3] McCabe, Louis C., Some plant structures of coal: Trans. Illinois State Acad. Sci. Vol. 24, p. 325, 1931.

NEW RESEARCH IN ILLINOIS COAL BALLS

BY

A. C. NOÉ

University of Chicago, Chicago, and Illinois State Geological Survey, Urbana

During the last year, several hundred coal balls from the former strip mine at Calhoun, Richland County, were sectioned. This coal was classified by Worthen as seam No. 13 or 14, which places it stratigraphically high in the upper part of the McLeansboro formation, the youngest formation of the Pennsylvanian system.

In order to examine the coal balls rapidly, they were quartered and the surfaces of the cuts were treated with cellulose film. In order to obtain a cellulose film, the surface of the coal ball must first be smoothed and then etched with hydrochloric acid. A layer of calcium is thus removed and the carbonized cell walls protrude from the surface like fibres of velvet. If a solution of cellulose is poured over this surface the cell walls become embedded in the cellulose film which easily peels off. This process proves that no replacement of organic substance takes place, but that the cell walls are actually preserved. We may conclude that the theory which assumes a complete destruction of cellulose by bacterial action in the coal swamp does not seem to be borne out by facts, as far as observations of coal balls indicate.

A close comparison between the coal balls from coal No. 5, Harrisburg, Illinois, from the Pyramid Coal Company, near Duquoin, from coal No. 6, and from coal No. 7, Danville, Illinois, with those of the Richland County coal give the following results:

1. They are richer in fern sporangia, containing a type which belongs probably to the genus *Sturiella*, but of a new species[1].
2. These coal balls are richer in various fern steles, especially of the genus *Botryopteris*.
3. Various Lepidodendron stems seem to be close to the species *Lepidodendron vasculare*.
4. A new Sigillaria type occurs which has not yet been named.
5. A new Bothrodendron type is also present.
6. More than one species of *Stigmaria ficoides* is observed.
7. Except for a number of new species, the coal ball floras of coals Nos. 5, 6, 7, and 14 do not differ radically. They even seem to have a large number of species in common.
8. Contemporary Upper Carboniferous floras of Western Europe and of America differ from each other far more than has been generally assumed.

[1] Mr. Roy Graham, University of Chicago, is preparing a doctor's dissertation on this new fern sporangia.

ORIGIN OF THE GREAT LAKES BASINS

BY

Francis P. Shepard

University of Illinois, Urbana, Illinois

ABSTRACT

The importance of ice erosion in the excavation of the Great Lakes is discussed. It is concluded that the basins were excavated primarily by ice and that diastrophism and glacial damming of former river valleys have had only minor effects. Reasons for this conclusion are as follows:

(1) Basins of this type are common particularly around the periphery of areas of continental glaciation. Many of these basins have been overlooked since they are submerged below ocean level in various arms of the sea.

(2) Similar basins are lacking in the areas directly outside of the margins of the glaciated tracts.

(3) The Great Lakes are both too deep and too wide to be considered the product of river erosion near the north south continental divide. However, ice erosion may have followed old river valleys of small proportion.

(4) Post glacial warping seems to have had little to do with the basins since it was of a type which would have tended to eliminate rather than form basins of this type.

(5) The shape of the basins is typical of glacial erosion.

(6) The size of the moraines beyond the lakes is comparable to the amount of material which would have been excavated if ice had been the chief factor. Also the nature of the drift suggests origin in the weak rocks of the lake basins.

EVOLUTION OF PTEROTOCRINUS IN THE EASTERN INTERIOR BASIN DURING THE CHESTER EPOCH

BY

A. H. Sutton

University of Illinois, Urbana

ABSTRACT

The evolution of *Pterotocrinus*, an aberrant and highly specialized genus of Camerate crinoids is traced. Under the influence of the rapidly and constantly changing conditions in the Eastern Interior Basin, *Pterotocrinus* evolved into a large number of species most of which are grouped into three principal evolutionary lines or "gentes". The genus is shown to have started in early Chester time, to have expanded into the greatest number of species during the middle Chester, and to have continued until the close of the Mississippian period. The possible ancestry of the genus is discussed. The practical value of certain species as stratigraphic markers in the Chester (Upper Mississippian) series is pointed out. Fourteen new species are defined and thirteen earlier described species are redescribed, bringing into one paper all that is known to the writer concerning this genus.

THE DEPOSITIONAL BASIN OF THE SPRINGFIELD (NO. 5) COAL IN NORTHERN ILLINOIS[1]

BY

H. R. Wanless

University of Illinois and State Geological Survey, Urbana, Illinois

ABSTRACT

The Springfield (No. 5) coal of northern Illinois was deposited in a basin which permitted a maximum accumulation of coal near its southern margin. The thickness of the deposit diminishes gradually toward the north to the point where the coal lenses out completely. The basin had its principal elongation from east to west and may have extended originally much farther west than the present erosional boundary of the coal. The southern margin of the coal is abrupt, and follows a line trending about N. 65° W., passing near Mt. Sterling in Brown County, and Chatham in Sangamon County. The basin is about 100 miles in width from north to south in western Illinois.

[1] Published with the permission of the Chief, Illinois State Geological Survey.

PAPERS IN MEDICINE AND PUBLIC HEALTH

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

The program for the Medicine and Public Health Section comprised seven articles, all of which were presented, and a moving picture film.

"Air Sickness," by Major L. W. Ballantyne, U. S. Army, Chief Flight Surgeon, Chanute Field, Rantoul.

"The Place of Milk Sanitation in Safeguarding Public Health," by Dr. N. O. Gunderson, Commissioner of Health, Rockford.

"Effect of Early Vitamin B Depletion on Learning Ability," by Dr. Siegfried Maurer, Chicago.

"The Thermal Death Time of *Brucella suis*," by S. E. Park, Assistant Bacteriologist, State Department of Agriculture, and Dr. Robert Graham, Laboratory of Animal Pathology and Hygiene, University of Illinois.

"Water Supply and its Relation to Public Health in Chicago," by T. Schmid, Jr., Assistant Sanitary Engineer, Department of Public Works, City of Chicago.

"Industrial Medicine as an Important Phase of Public Health," by Dr. C. O. Sappington, Consultant in Industrial Hygiene, Chicago.

"Wells, Rivers, and Water-borne Disease," by Charles H. Spaulding, Chief Chemist, Water Purification Plant, Springfield.

"Cancer—the Canti film—showing the behavior of living tissue in Vetro and the effect of radium upon cancer cells," by Dr. Gilbert Fitzpatrick, F.A.C.S., Chairman Illinois Chapter American Society for the Control of Cancer.

Average attendance at the section meeting was twelve; maximum, fifteen.

Dr. N. O. Gunderson, Commissioner of Health, Rockford, was elected chairman of the section for 1932-1933.

(Signed) HARRY F. FERGUSON, *Chairman*

THE PLACE OF MILK SANITATION IN SAFEGUARDING PUBLIC HEALTH IN ILLINOIS

BY

N. O. GUNDERSON, M. D.

Commissioner of Health, Rockford, Illinois

ABSTRACT

This paper reviews the need for control of milk supplies as evidenced by milk-borne epidemics, and discusses the control measures in use. It points out that early attempts to control the milk largely by stipulating the environment under which it is produced have given place to attempts to measure in the milk itself the qualities that make it attractive to the consumer. For instance, richness is indicated by the Babcock test; safety is indicated by the word "Pasteurized" on the bottle cap; cleanliness is indicated by the sediment test; and keeping quality is indicated by the reductase test of the raw milk, which, if desired, may be further corroborated by the use of the bacterial plate count, the Breed and Frost Little plate tests.

Although great progress has been made in the sanitary control of milk supplies in Illinois, more has been accomplished in the larger cities than in the smaller ones, principally through the activities of efficient health agencies that are vigilant in the use of pasteurization and other control measures to protect their milk supplies. The greatest hope for further prevention and reduction of milk-borne disease lies in persuading the smaller cities to avail themselves of the protection that pasteurization offers, and through legislation to place the supervision and control of milk, whether used for pasteurization or sold directly to the consumer in the raw state, under the jurisdiction of the Illinois Department of Public Health.

THE THERMAL DEATH TIME OF *BRUCELLA SUIS*

BY

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Laboratory of Animal Pathology and Hygiene

University of Illinois, Urbana

Studies on the thermal death time of two strains of *Brucella suis* in artificially contaminated milk were based upon two premises which imply that milk-borne *Brucella suis* may be a public health problem.

1. *Results of investigations in recent years suggest that milk contaminated by Brucella suis may be regarded as one of the possible sources of undulant fever.* Porcine strains of *Brucella* have been isolated from the blood stream of undulant fever patients, where contact with infected animals did not appear to be the source of infection. Strains of *Brucella*, believed to be porcine, have been isolated from cattle in dairy herds, incriminated in outbreaks of undulant fever. Cattle, artificially infected by intravenous injection and feeding of *Brucella suis* have shown occasional udder infection. This interhost susceptibility of man and cattle to swine strains of *Brucella* has created a problem in public health, one phase of which is the possibility of a milk-borne, porcine infection in humans.

2. *The possibility of infected cows' milk producing porcine brucelliasis in man emphasizes the importance of appraising the value of milk pasteurization temperatures in the elimination of this health hazard.* This

has raised the question as to whether various strains of *Brucella suis* would be killed by pasteurization as routinely conducted in commercial plants. Conflicting data on the thermal death time of porcine strains have presented public health officials with the problem as to the risk involved in the use of *Brucella suis* contaminated milk, although pasteurized, for human consumption. In an effort to appraise the reliability of milk-pasteurization standards in the prevention of milk-borne porcine brucelliasis, the results obtained in determining the thermal death time of two strains of *Brucella suis* at the Illinois Experiment Station are given. Since porcine strains appear to be more heat-resistant than bovine strains, the observations here reported may apply to bovine as well as to porcine strains.

EXPERIMENTAL DATA

Samples of sterile skim and whole milk, inoculated with varying amounts of a 24-hour growth of strains A and B of *Brucella suis* were heated in 5-cubic centimeter portions in cotton-stoppered tubes or 1-cubic centimeter amounts in hermetically sealed glass tubes. Strain A was isolated from an aborted porcine fetus and strain B from a porcine osteomyelitic lesion. The temperature at which the tubes were heated did not vary more than one degree. Viability of *Brucella* in the heated samples was determined by direct cultural methods.

Cotton stoppered tubes.—Strains A and B of *Brucella suis* were rendered non-viable in skim milk, containing approximately 5,000 organisms per cubic centimeter, at 140°, 142°, and 144°F. for 30 minutes (cultural results checked by animal inoculation). Neither strain of *Brucella suis* survived 30 minutes at 144°F. in skim milk containing approximately 50,000 organisms per cubic centimeter. Skim milk, inoculated with approximately 1,000,000 and 10,000,000 organisms per cubic centimeter, heated for 30 minutes at 144°F. did not yield strain A, but strain B survived in samples similarly inoculated and heated. Strains A and B survived 30 minutes at 144°F. in skim milk samples, containing approximately 100,000,000 organisms per cubic centimeter. Sterile whole milk samples, containing approximately 50,000 and 1,000,000 organisms per cubic centimeter, did not yield viable *Brucella suis* after 30 minutes at 144°F. However, both strains survived 30 minutes at 144°F. in whole milk samples, that contained approximately 10,000,000 organism per cubic centimeter.

Sealed tubes.—Although strains A and B of *Brucella suis* remained viable in whole milk samples that contained approximately 100,000,000 organisms per cubic centimeter when heated in cotton stoppered tubes for 30 minutes at 144°F., neither strain was viable after 7 minutes at 144°F. in similarly inoculated samples heated in hermetically sealed glass tubes. Both strains, however, survived in sealed tubes for 5 minutes. Whole milk, containing approximately 500,000,000 organisms per cubic centimeter, also yielded viable *Brucella suis* strains A and B after being heated in cotton stoppered tubes for 50 minutes at 144°F. In sealed glass tubes this milk yielded viable *Brucella suis* after 30 minutes at 134°F., 15 minutes at 140°F., 10 minutes at 142°F., and 5 minutes at 144°F. At 140°, 142°, and 144°F. *Brucella suis* strains A and B were killed in 20, 15, and 7 minutes, respectively.

Conclusion

The results of heating milk, artificially contaminated with two strains of *Brucella suis*, support the following:

(a) A variance to heat resistance was noted in two porcine strains.

(b) *Brucella suis* mass contamination in milk, in sealed tubes, was destroyed within the pasteurization range, permitting the inference that pasteurization prevents milk-borne porcine brucelliasis.

INDUSTRIAL MEDICINE AS AN IMPORTANT PHASE OF PUBLIC HEALTH

BY

C. O. SAPPINGTON, M. D., Director of Public Health

Consultant in Industrial Hygiene, Chicago, Illinois

ABSTRACT

Industrial medicine, sometimes called industrial hygiene and industrial health, has been properly termed the clearing house of organized public health work.

In the words of Prof. C. E. A. Winslow: "Public health is the science and art of preventing disease, prolonging life, and promoting physical health and efficiency through organized community efforts, for the sanitation of the environment, the control of community infections, the education of the individual in principles of personal hygiene, the organization of medical and nursing service for the early diagnosis and preventive treatment of disease, and the development of the social machinery which will ensure to every individual a standard of living adequate for the maintenance of health; organizing these benefits in such a fashion as to enable every citizen to realize his birthright of health and longevity."

Industrial hygiene has been variously defined by different people, but perhaps the simplest definition is as follows: industrial hygiene is a specialized form of medical and public health practice combining certain elements of medicine, engineering, chemistry, toxicology, psychology, sociology, statistics, and the principles of the prevention of disease, to the end result that the physical and mental efficiency of the worker is increased and production bettered in quality, quantity, and permanence.

There are various interpretations of the field of industrial hygiene. Watkins, in 1920, expressed the following viewpoint: "It took the medical profession quite a while to realize that the possession of a sound medical education did not *per se*, qualify a man adequately to carry on the duties of a health officer. The profession has likewise been somewhat slow to recognize that the acquisition of sound surgical technique or skilled diagnostic ability does not qualify a man to carry on the duties of an industrial physician." Likewise, Dr. A. J. Lanza, who in 1931 was chairman of the Section on Preventive and Industrial Medicine and Public Health of the American Medical Association, stated in his chairman's address in Philadelphia: "Although there are able and experienced industrial physicians competent to deal with any situation which may confront them, one still finds all too frequently physicians who have had no real appreciation of the nature and effect of working conditions and only an imperfect conception of the pathology, symptoms, treatment or prevention of specific occupational diseases."

The fundamentals of industrial medical service have been variously defined, but very succinctly quite recently by Dr. James A. Britton, as follows: (1) Examination of all new employees; (2) periodic re-examination of all employees; (3) routine and regular inspection of all working conditions and special supervision of all those conditions where there is a definite health hazard; (4) consultation and advice to any employee on personal health problems; and (5) active cooperation in community health activities. These are stated to be the minimum requirements for an

industrial health service that is worthy of the name and it is added that the cost of a well organized competent medical department which regularly and satisfactorily carries on all these functions will not be an impossible burden on industry; if industry does less, it is not carrying its full share.

The personnel of industrial hygiene is quite large and varied in its scope and consists of those who minister to the human body and its functions (including the physician, nurse, dentist, nutrition expert, psychologist, and physical trainer); those who have to do with the physical environment (the chemist, sanitary engineer, and sanitary inspector); those who have to do with the social environment (the sociologist, the social worker, the statistician, lawyer and physical educator); and finally, those engaged in fighting enemies in the parasitic environment (the bacteriologist and the protozoologist). Not all of these persons will be found in any one modern industrial medical service, but each one of them will be found in widely scattered industrial medical units, and in certain of these it would be difficult to progress without them. The physician is and probably always will be the leading figure in industrial hygiene; his chief work is to coordinate the work of the rest of the personnel, in much the same way that the diagnostician coordinates the efforts of various specialists and determines the possible program in each case.

It has been rather difficult to measure the tangible results accruing from the application of the principles of industrial medical practice chiefly because of lack of records kept before and after services have been established. However, the results of recent surveys have shown that absenteeism has been decreased an average of fifty per cent; a reduction in accident frequency has been lowered forty-three per cent; and the reduction of compensation insurance costs in the neighborhood of twenty-eight per cent. These figures were based upon a survey including a large number of organizations.

Opportunities for future development in the field of industrial hygiene and medicine are without limitation. For instance, McCord, a prominent industrial hygienist, has stated that health services have not been applied to more than four per cent of the existing industries in this country. From an economic point of view, it is now possible to cause a health service not only to pay for itself, but to yield dividends in terms of decreased absenteeism, decreased labor turnover, decreased compensation costs, and decreased accident frequency.

Finally, a conservative point of view gives to industrial medicine unlimited chances for the betterment of human kind because it provides the possibility of health supervision of forty to fifty million employees, which opportunity is not available through any other source. Realizing these opportunities the well-known industrial phrase "the public health is dependent upon the health of a nation's workers," becomes not merely a slogan but an industrial and economic principle worthy of the highest consideration and development.

WATER SUPPLY AND ITS RELATION TO PUBLIC HEALTH IN CHICAGO

BY

T. SCHMID, JR.

Assistant Sanitary Engineer, Department of Public Works, Chicago

ABSTRACT

Perhaps no item has had so great an effect on public health conditions in Chicago as the quality of the public water supply. This is only natural because water is the one item of diet which every citizen must use.

As Chicago grew, a demand arose for water for fire protection and domestic purposes which led to the building of the first water works by the Chicago Hydraulic Company in 1836. This system which took its supply a few hundred feet from the shore of Lake Michigan and distributed it through bored log mains soon became the source of numerous complaints of inadequate service and poor quality water. Chicago's own water board was organized in 1852 and a campaign launched against unsatisfactory health conditions to lessen the toll of typhoid and dysentery. No sooner had the city water works been built than the intake, which was about 600 feet off shore, was found to be in a zone of sporadic pollution and, as the city continued to grow, the frequency of pollution periods and the degree of pollution became more intense. Finally in the early sixties conditions became very acute, the water very objectionable and its taste and odor pronounced at times, resulting in a situation which forced the building of Chicago's first tunnel under Lake Michigan to an intake two miles from shore. This five foot tunnel which is still in use marked the beginning of the present water works system. It is very unfortunate that accurate statistical data of deaths from water-borne diseases are not available for this period which was unquestionably the darkest era in the city's history, insofar as public health was concerned.

Public improvements were not able to keep pace with the growth of the city, with the result that Chicago had to pay the penalty which every community has paid where the increase in population is out of proportion to that of the sanitary facilities. It is a well known fact that such epidemic diseases as cholera, typhoid fever and associated intestinal disturbances have followed in the wake of every concentration of population, whether temporary or permanent, unless adequate provisions were made for the proper disposal of human wastes.

Accepted factors in typhoid fever distribution are our water supply, our milk and food supply, and personal contact. Progress made in improving the Chicago water supply is especially reflected by a resumé of the typhoid fever death rates. In the water-borne epidemic years of 1872, 1881, 1891-2, typhoid fever was the most common disease which physicians were called upon to treat—today it is among the rarest.

Prior to 1893, analyses of water were of a chemical nature and methods of disease control were based largely upon the "filth" theory[1]. The great discoveries in bacteriology which were announced in the 80's were applied to the practice of curative and preventive medicine in the early 90's, resulting in a remarkable reduction in the typhoid fever rate from 173.8 in 1891 to 37.5 in 1894. During the development period which followed in the next decade the rate was again materially lowered.

By far the most important step taken towards safeguarding Chicago's water supply was the opening of the drainage canal in January, 1900, permitting the diversion of sewage wastes away from Lake Michigan.

Pasteurization of milk, inaugurated in 1908, also aided materially in eradicating typhoid from metropolitan Chicago.

The value of chlorine compounds for disinfecting water was shown in 1908 by C. A. Jennings at the Union Stock Yards in Chicago and within a few years water supplies throughout the country were being treated with chlorine. Although experimental chlorination was tried at Chicago intake cribs in 1912, it was not until December of 1916, that the entire water supply was continuously chlorinated. The typhoid death rate then dropped from 5.1 in 1916 to 1.6 in 1917. Since that time there have been two localized typhoid fever outbreaks on the south side of Chicago. The first, which occurred in 1916, resulted from a flooded sewer in the vicinity of the 68th Street Pumping Station. The second, in 1923, was either caused by an interruption in the chlorination process or the occurrence of abnormally heavy pollution in the raw lake water. Following the latter epidemic a program was established for maintaining rigid supervision over chlorination in Chicago. Modern chlorinating equipment was purchased, each pumping station was provided with duplicate chlorinating units and three shifts of chlorine attendants to give their full time to the chlorination of the water supply.

Trained sanitary engineers of the Water Purification Division of the Bureau of Engineering are charged with the responsibility for chlorination control from the time the water leaves the crib until it reaches the consumer's home. Administrative supervision such as this is of vital importance[2]. The Chicago system for chlorination control is today recognized as one of the most efficient and has frequently been used as a model by other cities. Its low per capita cost as indicated in the table, is an outstanding feature.

Distribution of 1930 Per Capita Costs

Item	Cost	Percent of Total Cost
Applying chlorine	0.0338	34.9
Chlorine gas	0.0254	26.3
Water pollution Inspection	0.0138	14.2
Laboratories	0.0126	13.0
Engineering and supervision	0.0089	9.2
Collection of samples	0.0023	2.4
Total cost	0.0968	100.0

Acknowledgments.—The writer wishes to express his gratitude to Mr. Arthur E. Gorman, Engineer of Filtration, Department of Public Works, for his helpful suggestions, and to officials of the Chicago Board of Health for their assistance in securing the statistical data upon which this paper is based.

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[3] Falk, I. S., Journal Preventive Medicine Vol. 1, p. 68, September, 1926.

PAPERS IN PHYSICS AND CHEMISTRY

Extract From the Report of the Section Chairman

The thirteen papers on the Physics and Chemistry program were all presented at the section meeting and all but two are herein published.

"Photography of atom building," by H. D. Harkins, University of Chicago, and "The chemistry of gallium," by Warren C. Johnson, University of Chicago, were not presented for publication.

Four papers were presented in joint session of the Physics and Chemistry groups, after which the two groups separated. Five additional papers were then presented before the Chemistry group and four before the Physics group.

The attendance was as follows: joint session, average—sixty, maximum—eighty-five; Chemistry division, average—thirty-five, maximum—fifty; Physics division, average—twenty-five, maximum—thirty-five.

It was voted to elect separate chairmen for the two groups but it was the desire of some that they should cooperate and probably have some papers in joint session. Chairmen elected for 1932-1933 are: for the Chemistry division, Dr. George C. Ashman, Bradley Polytechnic Institute, Peoria; for the Physics division, Otis B. Young, Southern Illinois State Normal University, Carbondale.

(Signed) E. H. Williams, *Chairman*

THE CHEMICAL STERILIZATION OF PUBLIC WATER SUPPLIES

BY

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Probably 60 per cent of the population of the United States is enjoying the health protection which comes from the use of sterilized water supplies. Assuming an average per capita daily consumption of 100 gallons, it follows that there must be the collection, filtering, often the softening, the sterilization and distribution through an intricate system of underground conduits at a fairly constant pressure, of approximately seven and one-third billion gallons daily. Here is a triumph of science and engineering of which the consuming public is scarcely aware, and whose attention is called to the quality of the product only on those rare occasions when an unusual taste or odor is found in the supply. Its bacterial quality is such that over long periods of time not a single organism may be found in a ten cubic centimetre portion. This service is rendered at a cost of approximately one cent per day per person.

The wholesale sterilization of water supplies in the United States began about 1910. Nowhere is the efficacy of the process more evident than in the decline of deaths from typhoid fever which is so generally a water-borne disease. In 1910 the rate per 100,000 of population in the United States was 22.8, in 1920, 7.6, and in 1930, 5 (1).

In terms of human lives saved, these figures mean a yearly conservation of 21,894 and the number who have yearly escaped the disease is probably five times as great. That this saving in human life and suffering can largely be attributed to sterilized water supplies is shown in the case of the city of Milwaukee (2). In 1916, the sterilization of lake water with chlorine was discontinued for a period of eight hours. There resulted 50,000 or 60,000 cases of gastro-intestinal trouble and within the next few weeks 400 or 500 cases of typhoid fever with 40 to 50 deaths. Again, the city of Olean, New York (3), having a population of 21,600 had an outbreak of the disease in 1928, traceable to faulty operation of the city's water sterilization equipment, in which there were 248 cases and 25 deaths. The city was empowered to issue $425,000 in bonds to cover its liability. Merchants estimated a loss of $200,000 in business while $125,000 was expended on improvements in the waterworks, making the total water bill for the city $750,000, which is a per capita cost of $34.80.

In Illinois where 52 per cent of the inhabitants use chlorinated water, it is clearly apparent that regions of high population have low rates, while rural areas have high rates.

Typhoid Fever in Illinois in 1931 (4)

Part of State	Population	Cases	Deaths	Rates	
				Case	Death
Northern (33 counties)..	5,648,608	223	29	3.9	0.5
Central (35 counties)....	1,150,547	158	25	13.7	2.2
Southern (34 counties)..	985,485	423	73	42.8	7.4
Total.....	7,784,640	804	127	10.3	1.6

It is to be observed that 12.7 per cent of the population, that of the 34 southern counties, had 52.6 per cent of the cases and 57.5 per cent of the deaths from the disease in the state.

In 1896, G. W. Fuller (5) applied chloride of lime to the raw water supplying the city of Louisville, Kentucky. A similar treatment was given the water supply of Maidstone, England, in 1897, and similar experiments were started five years later in Belgium. The animals in the Union Stock Yards, Chicago, in 1908, were given water from Bubbly Creek containing chloride. Ten years later the city began the chlorination of the public supply. In the last two decades the process has been perfected and has been extended so rapidly that the world traveller need never be far beyond its protective influence.

At the present time liquid chlorine is almost universally used. The liquid gasifies and then is carried into the water at a predetermined rate dependent upon the degree of pollution of the raw water. The fundamental chemical reaction is believed to be that in which hypochlorous acid is produced.

$$Cl_2+H_2O=HOCl+HCl$$

The hypochlorous acid is believed to be the sterilizing agent. In addition to this function the chlorine may chlorinate such materials as amino acids, unsaturated compounds and phenol bodies, if present in the water, while oxidizable substances such as aldehydes, ferrous and manganous salts, and hydrogen sulfide may be acted upon by the hypochlorous acid. These reactions necessitate an increase in the dosage in order to insure a high degree of sterilization. This may mean the application of two or more parts per million in order to obtain a residual amount of 0.2 or 0.3 parts per million. With chlorine selling at four cents a pound a dosage of 5 parts per million represents a cost of but $1.70 per million gallons, which means a per capita cost of about six cents yearly. In addition to its bactericidal value, chlorination prevents algae growths on filters and clarifying units at the water plant, thus increasing their usefulness.

THE PROBLEM OF TASTES AND ODORS

Chlorination of water containing organic materials frequently produces derivatives that have marked and disagreeable tastes and odors. Chlorinous tastes are produced by an excess of free chlorine, and chlorophenolic tastes result from the chlorination of phenolic bodies. The latter tastes and odors are much more pronounced and are, therefore, a more frequent cause of trouble. Thus, chlorinated ortho hydroxy benzaldehyde can be detected by taste to the extent of one part (6) to 1000 million parts of water, while the product arising from ordinary phenol is detectable one part to 100,000 million. The chlorophenolic tastes in the water of the south side of the city of Chicago are attributed to phenolic wastes poured into the lake at South Chicago and adjacent points. Phenols in stored water may also arise from decomposition of organic materials.

Taste prevention by use of chloramines.—In order to prevent the action of chlorine on organic substances present in the water, the practice has arisen of feeding both chlorine and ammonia to the water thus producing chloramines which are odorless, tasteless, and non-toxic to human beings, but more effective as germicides than chlorine, although somewhat slower in action.

The reactions involved are as follows:

(1) $Cl_2+H_2O=HOCl+HCl$

(2) $NH_3+H_2CO_3=NH_4HCO_3$

(3) $HOCl+NH_4HCO_3=NH_2Cl+2\ H_2O+CO_2$

(4) $2\ HOCl+NH_4HCO_3=NHCl_2+3\ H_2O+CO_2$

(5) $3\ HOCl+NH_4HCO_3=NCl_3+4\ H_2O+CO_2$

According to Chapin (7), the predominating reaction is determined by the hydrogen-ion concentration of the solution. Thus at a pH of 8.5 (1) the product is 100 per cent monochloramine (reaction (3)), while at 4.4 it is entirely dichloramine, (reaction (4)). Below 4.4, seldom met in water practice, reaction (5) sets in.

The formation of the mono- and di-chloramines through the use of ammonia saves the chlorine used in the treatment from being consumed by the organic matter, thereby preventing undesirable tastes and odors, and permits the carrying of a desirable chlorine residual of 0.2 or 0.3 parts per million for a longer time in the distributing system. In practice the ammonia dose is about one-half the chlorine. Recently the use of ammonium sulfate instead of ammonia has been adopted at certain plants.

Taste and odor removal by active carbon.—Charcoal has long been supposed to be highly efficacious when used as a filtering agent for the improvement of water. Ordinary, or non-active carbon has been found to have a phenol absorptive capacity of but one per cent of that of highly active carbon. For water treatment the carbon is finely powdered and of great absorptive surface. Garner, McKie and Knight (9) report that one cubic foot of active carbon, weighing 10 pounds, has a surface area of 3,000,000 square feet. It is fed into the water by means of a dry feed mechanism at the rate of about five parts per million parts of water or 42 pounds per million gallons at a cost of $2.10. The carbon is applied, of course, ahead of the filters. Such material furnishes inexpensive insurance against undesirable tastes and odors, while the application is so elastic that seasonal trouble may be taken care of. Such treatment is also of high value because the quality of the water holds the confidence of the public. Sterilization, accompanied by undesirable tastes and odors, in a considerable measure defeats its own purpose, but with the undesirable qualities removed it becomes a great human blessing.

Thus, through the combined efforts of science and engineering, one of the essentials of human existence, water, is practically no longer a vehicle for the spread of contagious diseases. The value of this in promoting public health is immeasurable.

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PURE AIR FOR OUR CITIES[1]

BY
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A city dweller, although he has the advantage of many modern conveniences and luxuries, pays a high price for silence and pure air. It is interesting to note what it is that polutes our city atmosphere. Large power plants are apparently the chief offenders, if one considers individual flues. The rather dense voluminous haze coming from them consists of solid particles produced as an ash by the burning of powdered coal. This ash is composed largely of inorganic materials and contains very little carbon, yet it seems to be sufficient to cut down materially the light rays from the sun and undoubtedly produce some irritation of lung tissue.

The resident of our cities in the Middle West not only has to contend with this form of air polution but is also subjected to varying amounts of sulfur gases produced by coal burners and present in the flue gases. The common coal used in this territory contains approximately four, sometimes six per cent by weight of combined sulfur which burns to sulfur dioxide in the ordinary combustion reaction. Tests also indicate the presence of a small amount of sulfur trioxide. It is well known that sulfur dioxide in any appreciable quantity in the atmosphere causes irritation to the mucous membrane as well as a destructive action towards growing plants.

Once the flue gases have been sent to the atmosphere, however, there is some question as to whether or not the sulfur dioxide reaches the ground in anywhere near the concentration—approximately three tenths of one per cent—that exists in the flue gases. The presence of fog would tend to increase the amount of sulfur dioxide brought to the ground within a definite area. The presence of solids, such as ash, might also bring about the same results. In other words, the sulfur dioxide may be absorbed by a water particle or adsorbed by a solid particle and carried to the ground by gravity.

The presence of a fog, without wind, apparently brings about some further oxidation of the sulfur dioxide to sulfur trioxide. The official Belgium commission appointed to investigate the Meuse Valley catastrophe has stated that such is their opinion. The atmospheric conditions in the Valley were apparently just right for the further oxidation of sulfur dioxide to sulfur trioxide with the result that large quantities of sulfuric acid were formed and rained down on the residents. Naturally if such was the condition, only the more hearty were able to survive without appreciable effects.

Although there seems little fear of such a catastrophe being reproduced anywhere in this country, the polution of the air with sulfur dioxide is not an aid to human health. The problem has been attacked in two ways —first, by removing the sulfur from the coal; second, by removing the sulfur dioxide from the flue gases.

Studies of the first method, which is the logical one, have been conducted along several lines: (1) the elimination of sulfur compounds from the coal by well developed washing methods, (2) the oxidation of the sulfur compounds to soluble sulfates and the leaching of the coal with water, and (3) the reaction of the sulfur compounds with some gas such as hydrogen to produce hydrogen sulfide which can be readily removed. Prob-

[1] This article is based on the work of Professors H. F. Johnstone and R. D. Snow of the Chemical Engineering Division of the Engineering Experiment Station, University of Illinois.

ably the final solution of this problem will be the utilization of some sort of heat treatment in connection with hydrogen gas after the coal has been subjected to mild oxidation, as laboratory tests have shown that at least 60 per cent of the sulfur can be removed from Illinois coal by these means.

The scrubbing of flue gas represents better possibilities of immediate solution, but this method will never solve the problem of air polution in our cities because it is impossible to conceive scrubbing or otherwise treating all the flue gases within a congested area. The work at the University of Illinois was based on the belief that it is possible to oxidize the sulfur dioxide to sulfur trioxide by means of the oxygen present in the flue gas, if a proper catalyst is present. Iron and manganese sulfates proved to be satisfactory catalysts when present even in relatively small amounts. Comparative tests indicate that one gallon of pure water will remove 90 per cent of the sulfur dioxide from 40 cubic feet of flue gases whereas one gallon of water containing a small amount of catalyst will remove 90 per cent of the sulfur dioxide from 2500 cubic feet of flue gases.

The work was originally done in the laboratory using a synthetic flue gas. Further work using actual flue gas from the University power plant did not give reproducable results because of the existence of inhibitors, apparently phenolic bodies. It was finally found that a direct current applied momentarily and periodically to the solution destroyed these inhibitors and permitted the catalyst to function over a long period of time. Sulfuric acid solutions were obtained with concentrations as high as 30 per cent acid.

The results of the experiments so far indicate that it may be economically possible to scrub the flue gases from our larger power plants and recover most of the sulfur dioxide incidentally removing a large portion of the solid material, which in itself is beneficial.

An interesting sidelight to the investigation is the problem of the disposal of the enormous quantities of dilute sulfuric acid. It is probable that most of the acid will be run to rivers or bays along with the alkaline waste products from industrial centers. Fish experts believe this would in no way injure the fish which live in the waters some miles below the point of entrance of the waste material. If it becomes possible to concentrate this dilute sulfuric acid at a reasonable cost this enormous source would be a distinct factor in sulfuric acid production in this country, but such a process is not now economically feasible.

Many engineering or physical problems must be solved before the scrubbing of flue gases to remove sulfur dioxide becomes an industrial success. Perhaps one of the most interesting problems is the question of increasing the rate of oxygen absorption in the water solution, the rate depending upon the pressure, temperature, surface, and time of contact. The chief resistance of this absorption is the stagnant liquid film in immediate contact with the gas and through which the gas passes only by diffusion. The basic requirement for the scrubbing operation is the elimination of this film or reduction of its thickness to the minimum. This can be done readily in standard equipment but unfortunately it is always accompanied by a high back pressure, not permissible in this particular operation. It is not economically feasible to force the flue gases through the scrubbing equipment under pressure because of the enormous quantity of gas to be treated and the corresponding high cost of power.

It may be said that, in spite of the many apparent difficulties, this problem of elimination of sulfur dioxide and solids from flue gases should be solved in the not far distant future. Work at the University of Illinois on this process and also on sulfur removal from coal should point the way to a solution of the general problem of air polution.

REACTIONS IN SOLIDS

BY

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INTRODUCTION

Within the last ten years many investigators, in quite diverse fields, have been studying reactions which take place in heterogeneous systems involving two or more solid phases. The problem is quite complex but the mass of data which has been accumulated now presents some degree of conformity. A complete historical development of the subject is unnecessary in this review and only the salient features of the various kinds of reactions are here discussed.

I—RECRYSTALLIZATION AND CRYSTALLOGRAPHIC CHANGE

When a crystalline metal has been subjected to cold-working, some of the atoms become displaced from the regular lattice of the crystals with the formation of a number of deformed regions. The process of restoration of the uniform lattice is called recrystallization. The theoretical treatment of the subject has been attempted in a recent paper by J. A. M. van Liempt.[1]

Crystallographic change is essentially a transformation from a metastable crystal lattice to one of greater stability.[2] From a consideration of the equilibrium $CaCO_3 \rightleftharpoons CaO + CO_2$, Langmuir[3] came to the conclusion that reactions of this type, which result in the production of two solid phases and a gas, can occur only at the interface between the two solid phases. Hume and Colvin extend this conception to the change from one crystal form to another. According to these authors three factors govern the course of the reaction: (1) rate of nucleation; (2) particle size; and (3) linear rate of preparation of the interface between the two solids.

The nuclei of the new lattice form at the surface of the solid, especially where it is deformed, and the formation of nuclei is preceded by a period of induction which depends upon the previous history of the substance. Mechanical deformation, according to van Liempt[1], should not be necessary, since the surface of the particle constitutes of itself a deformed area.

II—REACTIONS IN WHICH A SOLID DECOMPOSES TO GIVE A GAS AND A SOLID

A considerable amount of work has been done upon the dissociation of hydrates, carbonates, sulfates, etc. The investigations have, until recently, been limited to applications of the phase rule to these systems and the discrepancies[4] which appeared in the results of different investigations have led some to the conclusion that equilibrium in such systems either does not exist or is very difficult to attain[5].

For this type of reaction Langmuir (loc. cit.) suggested that the reaction took place at an interface between the two solid phases and in 1929 Hume and Colvin[6] showed that, in the decomposition of potassium hydrogen oxalate hemihydrate, the decomposition starts along crystal edges and spreads throughout the crystal at definite velocity when the temperature

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is constant. The same authors with Coppock[7] showed that potassium chlorate decomposition follows essentially the same mechanism. In a later paper Hume and Colvin[8], in an ingenious piece of research, have shown that, in the decomposition of $CuSO_4.5H_2O$ at low vapor pressures the velocity of propagation of the interface remained remarkably constant at constant temperature.

III—REACTIONS OCCURRING BETWEEN TWO SOLIDS

These reactions may include reactions such as:

$$BaCO_3 + Na_2SO_4 = BaSO_4 + Na_2CO_3$$
$$CaSO_4 + SiO_2 = CaSiO_3 + SO_3$$
$$BaO + PbCl_2 = BaCl_2 + PbO$$

They are generally carried out with powdered mixtures of the two reactants. This field has been reviewed in several papers in Germany notably by Tammann[9] and Hedvall[10]. The former shows that true equilibrium cannot exist in such systems. The reactions are in general characterized by a period of rapid initial reaction which occurs at a more or less definite temperature and a slower reaction which may or may not reach completion. The first rapid reaction takes place at the points of contact between the particles while the decrease of reaction rate is assumed to be due to the necessity, for at least one of the reactants, of diffusing through the layer of reaction product. Jander[11] and his co-workers have developed this field considerably.

The temperature at which a reaction begins is the point at which the atoms or molecules of one of the reactants become capable of position change due to increased vibrational energy. In some cases, a change of crystalline form takes place at this temperature; [12, 13] in some cases, a marked increase in electrical conductivity takes place. Ion deformation and the presence of impurities often influence the rate of reaction.

These apparently varied factors complicate the study of reactions between solids but it seems reasonable to hope that they may not be so different in their origin. Reaction between two solids takes place at the temperature at which the atoms have a certain mobility. In a mixture prepared by grinding the ingredients together it is highly probable that much deformation of the crystals should take place. The molecules, atoms or ions in these deformed regions will become capable of position change at a much lower temperature than those in the perfect lattice. Consequently the first rapid reaction may be assumed to be due to the presence of these deformed portions of the particles. Upon the removal of the deformation either by reaction with the other substance or by recrystallization, the reaction becomes slower. This may be due to the slow rate of diffusion through the reaction product or to the fact that only a few of the atoms or molecules, on the surface of the now perfect crystal, have sufficient energy to be capable of reaction. Let us assume that the latter factor is the major one. When one of the substances is undergoing a crystallographic change at the reaction temperature, the supply of these atoms or molecules which have the capability of position change is continuously replenished and the reaction will proceed to completion sometimes

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with considerable velocity. At temperatures below the transition point the number of atoms or molecules having the necessary energy is much lower but not necessarily negligible. The confirmation of Tammann's conception of diffusion being the main factor rests upon the fact that, when the fraction of a substance which has reacted is plotted against the logarithm of the time, a straight line results.

The writer has observed that when the results of Hume and Colvin (loc. cit.) upon the decomposition of $CuSO_4.5H_2O$, are plotted in this manner a straight line is also obtained. It is therefore possible that the diffusion theory is not to be accepted and that crystallographic transformation or the energy of the atoms or molecules on the crystal surface may be the controlling factors.

RECENT ADVANCES IN THE CHEMISTRY OF THE RARE EARTHS

BY

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The outstanding achievements in rare earth chemistry in recent years have come from investigations concerned with the fundamental chemical properties of these elements. This paper is an abstract of the more important articles of this nature, and of the work done at the University of Illinois during the past two years.

Fractional crystallization of the cerium group double magnesium nitrates and of the yttrium group bromates still continue to be the most important methods for the separation of the individual rare earths. Rolla and Fernandez[1] have suggested the use of the mixed double magnesium and double manganese nitrates for the separation of the cerium group earths. From their studies, the solubilities, in water, of the pure double manganese nitrates and the double magnesium nitrates increase with increasing atomic number, while the solubilities, in the solid state, of the double manganese salts in the corresponding double magnesium nitrates decrease with increasing atomic number.

The separation of certain rare earth sulfates by a partial thermal decomposition of the sulfates and a subsequent leaching with water has been undertaken by Willard and Fowler[2]. They determined the products formed in such decompositions and the dissociation pressures of the pure anhydrous sulfates at definite temperatures. Separations were attempted by maintaining the partial pressure of the sulfur trioxide above the heated mixed sulfates at a value intermediate between those of the pure constituents, so that the sulfate of one rare earth would be decomposed to its insoluble oxide, while the other remained as the soluble sulfate. The results were negative, since a solid solution of the oxides results when a mixture of the isomorphous sulfates is decomposed. Since cerium sulfate decomposes to the non-isomorphous cerium dioxide, separations of this element are successful. The procedure was applied to various types of mixtures.

Wells[3] has reported the varying solubility in ether of mixtures of rare earth nitrates which have been very carefully heated. He has suggested that the startling differences in the solubilities of the individual

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rare earths may be due to variations in the degree of dehydration of these salts. Studies at the University of Illinois have shown that, under uniform conditions, the minimum temperature to convert the rare earth monohydrate to the anhydrous salt varies considerably from one rare earth to the next.

Jantsch and Skalla[4] have prepared anhydrous samarium tri-iodide by gradually heating the hydrated salt with ammonium iodide to 350° C. and finally to 650°. The tri-iodide, when heated in a steam of dry hydrogen to about 760° C., decomposes to the deep green samarium di-iodide. Some of the properties of the di-iodide are given. Jantsch, Skalla and Jawurek[5] have studied the thermal decomposition of the trihalides into the dihalogen compounds.

Yntema[6] has prepared europous sulfate by the electrolytic reduction of an europic salt in the presence of the sulfate-ion, thus separating europium from gadolinium and samarium. Ball and Yntema[7] used the same method to obtain ytterbium containing only traces of the other earths from crude material containing only about ½ per cent of ytterbium.

New compounds of the rare earth elements have been described by Kolthof and Elmquist[8], Pagel and Brinton[9], Klemm[10] and his coworkers, Zhukov[11], Sieverts and Gotta[12], Picon and Cogné[13]. Physical constants of most of these compounds are also given.

Schwarz and Geise[14] and Lejeune[15] consider the compound formed when cerium salts are oxidized by air or by hydrogen peroxide in alkaline solution as a derivative of cerium dioxide in contradistinction to the views of previous investigators who held that the compound was a derivative of CeO_3, in which cerium had a valence of six.

Concentrated amalgams of lanthanum and neodymium have been prepared by Audrieth[16] and coworkers and that of cerium by Biltz and Meyer[17] and by Muller and Schmidt[18].

Baxter and Behrens[19] have redetermined the atomic weight of lanthanum as 138.926, a value 0.026 higher than the present international value. Prandtl[20] has prepared very pure samples of erbium for atomic weight determinations by a combination of several basic precipitation methods.

Spedding [21] has diagrammed some of the energy levels of GdIV for the temperatures of liquid air and liquid hydrogen as a result of his study on the ultra violet absorption spectra of $GdCl_3.6H_2O$ and $GdBr_3.6H_2O$ in a magnetic field. Uzumasa and Okino[22] suggest a relationship between the dielectric constant of the solvent and the shifts in the absorption bands as a result of their studies on the absorption spectra of praseodymium and neodymium hydrated nitrates in glycerol, acetone, methyl alcohol and pyridine.

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[4] Z. anorg allgem. Chem. *193*, 391 (1930).
[5] Z. anorg. allgem. Chem. *201*, 207 (1931).
[6] Jour. Am. Chem. Soc. *52*, 2782 (1930).
[7] Jour. Am. Chem. Soc. *52*, 4264 (1930).
[8] Jour. Am. Chem. Soc. *53*, 1225 (1931).
[9] Jour. Am. Chem. Soc. *51*, 42 (1929).
[10] Z. anorg. allgem. Chem. *190*, 123 (1930).
[11] Ann. inst. phys. Chem. *3*, 461 (1926); *3*, 600 (1927).
[12] Z. anorg. allgem. Chem. *172*, 1 (1928).
[13] Compt. Rend. *193*, 595 (1931).
[14] Z. anorg. allgem. Chem. *176*, 209 (1928).
[15] Compt. Rend. *191*, 665 (1930).
[16] Jour. Am. Chem. Soc. *53*, 1805 (1931).
[17] Z. anorg. allgem. Chem. *176*, 23 (1929).
[18] Monatsh. 53-54, *224* (1929).
[19] Jour. Am. Chem. Soc. *54*, 591 (1932).
[20] Z. anorg. allgem. Chem. *198*, 157 (1931).
[21] Phys. Rev. *38*, No. 4. 670 (1931).
[22] Bull. Chem. Soc. Japan. *6*, No. 6. p. 147.

The work of Willard [23] and Furman[24] and their coworkers has shown the usefulness of ceric sulfate solutions as oxidizing agents for volumetric anaylsis.

Takvorian [25] using an Indian monazite as starting material, obtained about five hundred grams of neodymium-samarium concentrates which he examined for the K and L series lines of illinium. His failure to find any trace of the element is undoubtedly due to the small quantity of original material he used. The arc spectra of these samples were also recorded and photometered and were found to correspond well with artificial mixtures of supposedly pure neodymium and samarium. Analyses made by one of us of samarskite by the magneto optic method have shown illinium to be present in this ore to the extent of about one part in ten million, showing that it is absolutely necessary to start with very large amounts of original material to get any detectable concentration of this rarest of the rare earths.

COLLOIDAL HYDROUS BERYLLIUM OXIDE*

BY

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Ever since 1861, when Thomas Graham[1] first drew a distinction between the two classes of solutes which he termed crystalloids and colloids the scope of colloid chemistry has increased until today it is associated with practically every branch of applied science. Consequently the definition of colloids and colloidal systems has become increasingly complicated. It is impossible to formulate any direct statement which will include even a few of the common colloids, such as milk, rubber, gelatin, clay, concrete, varnishes and cellulose esters. Today it is more or less arbitrarily considered that particles with diameters between 1 *mu* and 100 *mu* (10^{-7} and 10^{-5} cm.) are colloids. It must be remembered that these limits are not definite.

There has been much controversy concerning the stability factors of various colloidal systems, notably colloidal hydrous ferric oxide and the announcement by Sorum[2] of his so-called "chloride-free" ferric oxide sols. Therefore the author, under the direction of Professor Krauskopf, began the study of the preparation and properties of hydrous beryllium oxide sols in the hope of proving or disproving some of the stability theories.

Hydrous beryllium oxide sols[3] were made by heating syrupy beryllium chloride in large casseroles, using a small flame of an adjustable burner. When the material was nearly dry, that is, when only a few syrupy bubbles were forming, the flame was turned up to full height. When the redness of the flame could be seen through the bottom of the casserole, one liter of boiling water was added, the sol boiled for a minute and afterward allowed to cool in the air. If the water was not added at the proper time no sol resulted which showed that the chloride had to be quickly decomposed in order to produce the "oxychloride" apparently necessary for the preparation of a stable sol. Lately the writer has prepared sols which were about seven times as concentrated as those formerly produced. About eight grams of syrupy beryllium chloride were placed in a 150 cc. quartz evapor-

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[23] Jour. Am. Chem. Soc. *52*, 36, 132, 553, 557 (1930).
[24] Jour. Am. Chem. Soc. *52*, 1443, 2347 (1930); *53*, 1283 (1931).
[25] Compt. Rend. *192*, 1220, 1372 (1931).
*Contribution from the Chemical Laboratory of the University of Illinois.
[1] Graham, Trans. Roy. Soc. *151*, 183 (1861).
[2] Sorum, J. Am. Chem. Soc. *50*, 1263 (1928).
[3] Madson and Krauskopf, J. Chem. Edu. *6*, 334 (1929); J. Phys. Chem. *35*, 3237 (1931).

ating dish and heated with a small flame until the material was nearly dry. Then the dish and contents were quickly heated to redness and immediately plunged into a liter of boiling water. The sols thus formed were treated as before. After purification they were stable for only a few weeks.

The sols were purified by dialysis at about 75° C, for 12 to 168 hours in a Sorum dialyzer[4] using collodion membranes. The hydrogen-ion concentrations of the sols were measured by means of a glass electrode[5]. The pH values of the sols increased rapidly during the first few hours of dialysis due to the removal of free acid which had been formed by the hydrolysis of the beryllium chloride. The hydrogen-ion concentration decreased to a pH of 7.0 at fifty hours and then remained constant even though the sols were dialyzed for a week. This indicated that the sols were very stable.

Hydrous beryllium oxide sols belong to the class of sols known as lyophobic of suspensoid colloidal systems. Flocculation values give a relative indication of the stability of the various sols, especially if the values are determined under conditions for comparable work in the coagulation of colloids by electrolytes as outlined by Murray[6]. The flocculation values have been determined for sixteen inorganic electrolytes using purified beryllium oxide sols. Since the beryllium oxide sols were prepared from beryllium chloride it might be expected that they were stabilized by an excess of the salts. The amount of chloride present in the sols continued to decrease during more than one hundred hours of dialysis while the flocculation values were constant after twelve hours of dialysis. Therefore it seemed apparent that the sols were not the result of simple hydrolysis nor was the stability due only to adsorbed beryllium chloride. The stability of the systems has been attributed to: (1) some minute amount of beryllium chloride or oxychloride, (2) some minute amount of basic beryllium acetate, (3) the character of the hydrolysis, (4) the slight hydration of the oxide, and (5) the amphoteric nature of the oxide.

The size of colloidal hydrous beryllium oxide particles has been determined by the direct particle count method[7] using an ultra-microscope. Assuming that the particles were cubes, the average cube edge was 153.5 *mu*; assuming the particles to be spherical, the average radius of the particles was 95.3*mu*. This large particle size together with the slight hydration of the oxide may explain why only dilute sols of beryllium oxide have been prepared. Apparently if concentrated stable sols of hydrous beryllium oxide are to be prepared, conditions must be developed which will produce smaller particles, increase the hydration, or both. The particle sizes of the more concentrated sols previously mentioned have not been determined but it is expected that they would be much smaller in size than those formerly prepared.

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[4] Sorum, J. Am. Chem. Soc. *50*, 1263 (1928).
[5] Hazel and Sorum, J. Am. Chem. Soc. *53*, 49 (1931).
[6] Murray, Chem. News *123*, 277 (1921).
[7] Madson, J. Phys. Chem. *36*, 855 (1932).

THE PINACOL-PINACOLONE MOLECULAR REARRANGEMENT

BY

JULIUS STIEGLITZ, RUSSELL B. COOPER, and GEORGE W. AYERS, JR.

ABSTRACT

The rearrangement of pinacol to form pinacolone $(H_3C:)_2C(:OH):C(:OH)(:CH_3)_2=(H_3C:)_3C:C::O(:CH_3)+H_2O$ was studied from the point of view of theories developed by one of us to account for such other well-known molecular rearrangements as Beckmann's, Hofmann's, Curtius', etc., in which occur migrations of alkyl or aryl groups from carbon linkages to nitrogen. A source of instability, a "fault" in the molecule, leading to the rearrangement is found, in agreement with views expressed by Lauder W. Jones, in the electronic instability residing in the juxtaposition of two partially oxidized carbon atoms in the molecule of pinacol. Acids, which bring about the rearrangement, are considered to form oxonium salts which, by the loss of water, develop a positive free electric charge on one of the carbon atoms of alcohol character in pinacol. It is to this positive charge on a carbon atom that a negative methyl group, $:CH_3$, slips from the neighboring carbon atom in the actual rearrangement. In support of this view the velocities of rearrangement were studied (with R. B. C.) under the influence of various acids and of a given acid in different concentrations. The velocity coefficients increased with the strength of the acids and increased proportionally to the concentrations of a given acid.

Oxonium salts of pinacol formed with hydrogen bromide and hydrogen chloride were isolated (with G. W. A.) and the conditions under which these salts undergo the pinacol-pinacolone rearrangement, on the one hand, or are transformed into halides (the normal reaction of alcohols with halogen acids) were studied and defined. In accordance with the theory it was found that the ease of rearrangement of the halohydrines is in the order of chloro, bromo and iodohydrine—the same order as that of the well-known increasing activity of alkyl chlorides, bromides, and iodides.

THE "FLASH" IN THE AFTERGLOW OF ARGON WITH A FIXED VACUUM

BY

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In a recent number of the Philosophical Magazine the writer and L. E. Scheuerman described a "flash" that appeared in the afterglow of certain gases, notably nitrogen, when the residual gas was *suddenly compressed.* Recently (December 4, 1931) the writer while exhibiting the electrodeless discharge in a liter pyrex flask at the Butler meeting of the Indiana Academy of Science observed a flash in the afterglow with a *fixed* vacuum. This particular tube contained argon at a pressure of between 0.1 and 0.2 mm. of mercury, and was prepared in May, 1931. No record was kept of the moisture present, or of the purity of the gas. Mr. H. C. Roberts, assistant to the writer, said that this peculiar action of the gas was observed and briefly commented upon at the time the tube was sealed off, but for

some reason the phenomenon was passed by until the striking observation was again made as referred to above. A paper[1] recounting the above was read by title at the New Orleans meeting of the American Physical Society in December, 1931.

No definite experimental theory has as yet been attempted. The conditions for a flash are exceedingly difficult to obtain. Much time has been spent since the New Orleans meeting in attempts to prepare other flasks containing residual argon which would exhibit the flash but thus far all except one have proved unsuccessful. Argon from three different sources has been tried, and great care has been exercised in the moisture content and purity of the gas. Also much care has been taken in the outgassing of the pyrex bulbs previous to priming them with argon. To vary the conditions 12-liter and on down to 1-liter bulbs were employed. At no time was the slightest flash observed to accompany the afterglow. All this indicates that the optimum conditions for a flash are very critical. It seems that the inner surface condition of the flask is a factor, that impurities must be present in definite proportions and that the pressure of the residual gas must be exact. Possibly also the source of excitation must come within certain circuits. The liter bulb that seemingly works so well has failed on two or three occasions. The writer has taken this bulb with him on lecture trips and has failed twice to get results in seven or eight attempts. The source of energy was the 110 volt AC lighting circuit of the place visited. The failure was attributed to a possible low supply voltage at the time, since the exciting set-up was the same, of course, at each place. This is given as evidence that the conditions for producing the phenomenon are exceedingly critical and one is forced to conclude that the original bulb that does exhibit this flash is one possibly in a hundred.

Mention was made above of an exception. This was with residual air in a 12-liter bulb and was observed for a period of five to ten minutes only, when the condition for producing the flash was lost. We were not able to reproduce the flash though every effort was put forth to do so. In this instance it seemed decidedly to be a case of inner surface conditions and not the gas employed, for another 12-liter flask connected to the one in which the flash was observed exhibited no afterglow or flash, yet the same gas was in both and at the same pressure.

Thus we have but one bulb that exhibits this interesting phenomenon. The flash occurs within one or two seconds after the energizing source has been removed and is of sufficient brightness (when all goes well) to be observed by viewing it directly or by reflection on the walls of a darkened room. Following this the intensity of the afterglow changes color slightly and dies off rapidly. Some observers, who have viewed it critically, declare that additional flashes follow the initial one in decreasing brightness. This may be wholly subjective, the writer thus far has never observed any additional flashes.

Spectroscopic studies are planned. To date the energies of the writer have gone largely in the attempted preparation of additional flasks with the hope of intensifying the flash to better enable the spectroscopic studies to be made, but apparently with little success. This elusiveness makes the problem all the more fascinating.

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[1] C. T. Knipp, Abstract No. 64, Phys. Rev., 39, 5. Mar. 1, 1932.

DOUBLE-CRYSTAL X-RAY SPECTROMETRY

BY

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ABSTRACT

INTRODUCTION

X-ray spectrometry can be divided conveniently into three divisions: (*1*) production of the X-rays, (*2*) spectral analysis of the X-rays, and (*3*) measurement of the X-rays. In this abstract we shall confine our discussion to the analysis of the rays, or the separation of the beam into a spectrum.

Two considerations of prime importance confront us in all spectrometry: How accurately can we segregate a single wave-length from a beam? Will this more or less monochromatic beam have sufficient intensity to allow its study?

SINGLE-CRYSTAL SPECTROMETRY

The resolving power of any X-ray spectrometer is determined by two factors. The first is the imperfect collimating action of the slits, which can be termed the geometrical resolving power. The second is the physical resolving power, as set forth in the theory of crystalline diffraction, and can be expressed as the deviations from the Bragg law $n\lambda = 2d \sin \Theta$. The physical resolving power of a Bragg type single-crystal spectrometer is, for all angles of incidence, much greater than the geometrical resolving power, and we can say that the limit of the instrument is contained in its geometry. (See Phys. Rev. 38, 203 (1931).)

Divergence.—The angle of horizontal divergence of the beam incident upon the crystal may be defined as 2α and the vertical divergence as 2φ. Then $2\alpha = \frac{w_1 + w_2}{L}$ and $2\varphi = \frac{h_1 + h_2}{L}$ where w_1, w_2, h_1 and h_2 are the widths and heights of the confining slits S_1 and S_2 respectively, and L the distance between them. Assume for simplicity strict obeyance of the law $n\lambda = 2d \sin \Theta$, and, for the moment, that the incident beam is composed of purely monochromatic radiation. Considering all possible rays passing through the slits, the limiting divergence being the angles 2α and 2φ, one finds a certain small amount of radiation having the maximum vertical divergence and at the same time striking the crystal at the proper angle Θ for reflection but whose angle projected in the horizontal plane is greater than Θ by an amount ϵ. This particular ray is shown in the diagram by the dotted line. Simple trigonometry gives the value of ϵ as $\frac{\varphi^2}{2} \tan \Theta$. These considerations allow for the horizontal divergence of the incident beam an angular range $(\Theta - \alpha)$ to $(\Theta + \alpha)$ and for the reflected beam an angular range Θ to $(\Theta + \epsilon)$. Consequently, reflection of this wave-length takes place while the crystal is rotated through the range $(2\alpha + \epsilon)$, which is therefore the full width of an ionization or "rocking curve" taken for this wave-length.

Resolving power.—Two lines of wave-length difference $d\lambda$ are arbitrarily defined as resolved if, as in optical spectrometry, the "maximum" of one falls above the "minimum" of the other. This wave-length separation amounts to an angular separation of $d\Theta$, where $d\Theta = \frac{1}{2}(2x + \epsilon) = \frac{1}{2}(2\alpha + \frac{\varphi^2}{2} \tan \Theta)$

Also $d\Theta = \frac{nd\lambda}{2d \cos \Theta}$ from $n\lambda = 2d \sin \Theta$

Therefore $d\lambda = \frac{2d}{n} \cos \Theta \, (\alpha + \frac{1}{4}\varphi^2 \tan \Theta)$ which gives $\frac{\lambda}{d\lambda} = \frac{\tan \Theta}{\alpha + \frac{\varphi^2}{4} \tan \Theta}$

For a given wave-length, the only variables in this expression for the resolving power of a single-crystal spectrometer are a and φ. If the resolving power is to be increased, the widths and heights of the slits must be decreased or the distance between them increased. Either change results in a diminution of intensity, and a compromise between intensity and resolving power must be made. This compromise is inherent in all single-crystal spectrometers.

DOUBLE-CRYSTAL SPECTROMETRY

Instead of allowing the beam reflected from the crystal to pass directly into the ionization chamber let there be placed a second crystal so as to intercept the reflected beam. When this second crystal is properly orientated the beam will strike it at the glancing angle Θ and experience a second reflection. There are obviously two positions of the second crystal for which this orientation is effected. Case I and Case II or the "anti-parallel" and the "parallel" positions.

Geometrical width of a line.—The geometrical width of the line reflected from crystal A we have just seen to be $\epsilon_A = \frac{\varphi^2}{2} tan\ \Theta_A$. This angular range will therefore be the horizontal divergence of the beam incident upon the second crystal, B. The vertical divergence of the beam is unchanged by reflection from crystal A. Just as in the case of the first crystal, there will be an angle ϵ_B for the geometrical width of a single wave-length reflected from crystal B. Consequently, the curve obtained by rocking crystal B will have a full geometrical width of $\Delta\Theta$ given by

Case I	Case II
$\Delta\Theta = \epsilon_A + \epsilon_B$	$\Delta\Theta = \epsilon_A - \epsilon_B$
$\Delta\Theta = \frac{\varphi^2}{2} (tan\ \Theta_A + tan\ \Theta_B)$	$\Delta\Theta = \frac{\varphi^2}{2} (tan\ \Theta_A - tan\ \Theta_B)$

That the positive sign between ϵ_A and ϵ_B in case I must be replaced by the negative sign in case II can be seen from simple analysis of the two cases.

Dispersion.—Consider two lines in the incident beam separated by a wave-length difference $\delta\lambda$. Crystal A will give these lines an angular separation of $\delta\Theta_A$ and crystal B will separate them by $\delta\Theta_B$. It follows that if crystal A remains stationary, crystal B must be turned through an angle $d\Theta_B$ in order to reflect both lines. Now

$$\delta\Theta_B = \frac{n_A\,\delta\lambda}{2d\ cos\ \Theta_A} \quad \text{and} \quad \delta\Theta_B = \frac{n_B\delta\lambda}{2d\ cos\ \Theta_B}$$

$$d\Theta_B = \delta\Theta_A \pm \delta\Theta_B = \delta\lambda\left(\frac{n_A}{2d\ cos\ \Theta_A} \pm \frac{n_B}{2d\ cos\ \Theta_B}\right)$$

which gives for the dispersion

$$D \equiv \frac{d\Theta_B}{\delta\lambda} = \left(\frac{n_A}{2d\ cos\ \Theta_A} \pm \frac{n_B}{2d\ cos\ \Theta_B}\right),$$

the plus and minus sign applying to cases I and II respectively.

Resolving Power.—Applying the same definition of resolving power that we employed for the single-crystal spectrometer, two lines are resolved if they are separated by an angular range for crystal B of an amount equal to one half the geometrical full width of a single line. That is, providing

$$d\Theta_B = \frac{\Delta\Theta}{2} = \frac{\varphi^2}{4} (tan\ \Theta_A \pm tan\ \Theta_B).$$

The expression for D just derived, when multiplied by $n\lambda = 2d\ sin\ \Theta$, gives,

$$D \equiv \frac{d\Theta_B}{d\lambda} = \frac{1}{\lambda} (tan\ \Theta_A \pm tan\Theta_B)$$

Therefore $\frac{\varphi^2}{4d\lambda} (tan\ \Theta_A \pm tan\ \Theta_B) = \frac{1}{\lambda} (tan\ \Theta_A \pm tan\ \Theta_B)$ and $\frac{\lambda}{d\lambda} = \frac{4}{\varphi^2}$

It will be observed that this expression for the geometrical resolving power of a double-crystal spectrometer is identical with that obtained for a single-crystal instrument if $\alpha = 0$. In this sense, the first crystal can be said to act as an extremely effective collimator for the beam incident upon the second crystal. The greatest virtue of the two-crystal instrument lies in the fact that the resolving power is independent of the slit-widths, and a highly resolved beam of relatively large intensity is available. Actually the geometrical resolving power can be made much greater than the physical resolving power, and the limitations of the double -crystal spectrometer are then determined by the state of perfection of the crystals. That practically perfect calcite crystals can be obtained has been shown by the author (Parratt, Phys. Rev. *41*, 561 (1932).

ELECTRON FOCUSSING PROPERTIES OF CROSSED ELECTRIC AND MAGNETIC FIELDS

BY

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In magnetic deflection experiments for the determination of e/m for electrons, the difficulty of making an accurate measurement of the velocity of the electrons constitutes the principal uncertainty in the attainable precision of the determination. In 1929, Bartky and Dempster called attention to the remarkable focussing properties of crossed electric and magnetic fields and they deduced an equation for e/m which does not contain the velocity explicitly but involves simply the radius of curvature and the electric and magnetic fields.

The present work is an attempt to examine experimentally the focussing properties of crossed fields in order ultimately to make an accurate determination of e/m for electrons. Such a combination of fields which act simultaneously possesses the desirable property of focussing both in direction and velocity, if the variations are not too large. The method consists, essentially, of projecting a beam of electrons into a radial inverse first power electric field at the same time that a homogeneous magnetic field is established normal to the plane of the trajectory. With the proper combination of the two fields the electrons are brought to a focus 127° 17′ from the slit. A very fine wire is placed at this point in order to receive the electrons, and a maximum deflection of a galvanometer connected to the wire indicates symmetrical refocussing. When this occurs the radius of curvature of the beam is known from the geometry of the apparatus, and by measuring, on a potentiometer, the magnitudes of the electric and magnetic fields, e/m can be computed directly in terms of the electric and magnetic fields and the radius of curvature. Although the original equation for e/m does not contain the velocity explicitly, it is necessary that electrons of a suitable velocity be projected into the crossed fields. This velocity is adjusted to the proper value during the process of focussing. The sharpness of the focussing curves obtained thus far suggest that this combination of fields should permit of a determination of e/m with an accuracy of at least 1 in 2000.

One difficulty has arisen in the work due to the formation of polarized layers on the plates of the electric field. These layers operate to change the intensity of the electric field so that the intensity as measured externally will not be a true measure of the field actually deflecting the beam. It is possible, however, accurately to measure these extraneous potentials and work is in progress to develop a means of keeping them as constant as possible before a final determination of e/m is made.

INVESTIGATION OF THE WEHNELT CATHODE EXPLOSION

BY

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ABSTRACT

This work is preliminary in an attempt to determine the cause of the Wehnelt cathode explosion.

A discharge tube with a hot, coated platinum cathode was used. A "B" battery eliminator maintained a steady, low potential drop across the tube.

Experiments were performed in which different gases were introduced into the tube after the current had started. These experiments seem conclusive that the explosion is due to some action in the coating on the cathode and is not due to any sudden ionization formed by the introduced atmosphere. The active materials were barium oxide and No. 6 Express sealing wax. The gases used were air, hydrogen, and oxygen.

Further work was done to determine whether the explosion is due to a chemical action in the active coating. Here a platinum strip about 1½ mm. wide was cupped to hold a paste made of BaO, C and distilled water. When a potential difference of 60 volts per cm. was applied and the strip was heated to brilliance, the resulting chemical action produced instantly a discharge so great that it could not be measured with an Ayrton universal shunt and galvanometer. After 30 seconds the current decreased to a readable value.

The above experiment was repeated with a potential difference of 3 volts per cm. The discharge again began immediately but continued to increase for 5 minutes before starting to decrease.

It should be observed that the chemical action eliminates the necessity of priming and offers a possible explanation of the Wehnelt cathode explosion.

PAPERS IN PSYCHOLOGY AND EDUCATION

Extract from the Report of the Section Chairman

All six of the articles which comprised the program of the Psychology and Education Section were presented at the section meeting. Abstracts of four of them are here published. "Laboratory Method in Educational Psychology," by Guy T. Buswell, University of Chicago, was being published in the May issue of the *Elementary School Journal* and therefore is not included here. The article on "Supervised Teaching at North Central College," by C. E. Erffmeyer, was withdrawn from publication at the time that abstracts were requested in substitution for the full articles.

Attendance at the section meeting was only eleven, presumably because of an unannounced change in the place of meeting.

Ralph Pringle, Normal University, Normal, was elected chairman of the section for the 1933 meeting.

(Signed) M. M. Maynard, *Chairman*

EVOLUTION OF COLLEGIATE CHEMISTRY CURRICULA

BY

BRUCE W. MERWIN

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During the past half century the offerings of the various college departments of science have changed greatly, resulting at present in some uncertainty as to what new courses should be added as these different departments expand. It is the purpose of this paper to study the shifts in collegiate courses offered in chemistry, to try to show possible causes of these changes, and to see what the present tendencies are.

Three periods may be distinguished in the history of chemistry within the time studied: (1) an early period ending about 1880; (2) a middle division extending to 1910; and, (3) a recent one lasting until the present time.

During the first period, when the practical and the utilitarian dominated, the ideas of classification and philosophy and little experimentation were associated.

The second period, from 1880 to 1910, was characterized by the development of the laboratory, an expression of the growing scientific spirit, and the tendency to stress the study of laws and theories, all having as an aim the development and discipline of the mind, accompanied by a rapidly increasing tendency toward the utilitarian. The changes in subject matter and content indicate that the practical or utilitarian aim in college education had become widely adopted by the end of the century. The transition from the classical to the modern, from the theoretical and speculative to the practical point of view, evoked certain movements which in turn contributed toward the change in aim. The desertion of the disciplinary aim was responsible for the transition from required to optional work, for the shifts in the amounts of time allotted to the various subjects, for the introduction of new subjects and the repression of some of the old, and even for new methods of instruction and increase in enrollment.

Many of the recommendations of the Committee of Ten, 1893, are still reflected in the college offerings in chemistry. The more important recommendations were as follows: chemistry for those going to college or scientific schools and for those going to neither should be treated in the same manner and include the same content; chemistry should be taught by a "combination of laboratory work, textbook, and through didactic instruction carried on conjointly, and at least one-half of the time devoted to these subjects be given to laboratory work;" an entire year should be devoted to the subject; one-fourth of the time of the high school course should be devoted to nature studies, and this amount of preparation should be required for entrance to college.

The third period, extending from 1910, or perhaps a little earlier, to the present day, has witnessed a strong shift to the practical, the useful, in all school subjects, and an attempt to offer those things that will best fit the student for life in his community. These things are difficult to determine, and during the present decade numerous studies are being made to determine objectively just what subject matter should be included. A study of the table shows the efforts being made to enrich and make practical the work in the collegiate chemistry departments.

Distribution of Listed Courses in Chemistry by Percentages of Kansas Colleges Offering

Year	1870	1880	1890	1900	1910	1920	1925	1930
No. of Colleges	6	9	18	22	23	20	20	17
Subject	%	%	%	%	%	%	%	%
General Chemistry	83	78	83	82	70	75	65	94
Inorganic Chemistry	17	0	17	27	43	60	50	65
Qualitative	0	11	11	45	74	85	80	94
Organic Chemistry	0	33	17	46	74	100	100	100
Quantitative	0	11	17	36	52	85	95	100
Advanced Quantitative	0	11	6	9	9	20	25	71
Physical Chemistry	0	11	6	18	17	45	55	82
History of Chemistry	0	0	6	5	22	20	30	41
Industrial Chemistry	0	0	0	4	13	35	45	35
Glass Blowing	0	0	0	0	5	0	15	6
Teachers Course	0	0	6	0	0	0	5	29
Philosophy of Chemistry	0	0	0	5	0	0	10	0
Water Analysis	0	0	0	0	0	0	5	24
Assaying	0	11	6	9	17	20	15	24
Agricultural Chemistry	0	11	6	5	13	25	25	29
Physiological Chemistry	0	0	6	9	22	20	35	24
Household Chemistry	0	0	11	5	22	45	50	29
Experimental Chemistry	0	0	0	14	0	5	5	6
Photography	0	0	6	0	9	5	10	0
Fuel Analysis[a]	0	0	0	0	0	0	0	41[a]
Food Analysis	0	0	0	0	0	0	0	53
Oil Analysis	0	0	0	0	0	0	0	24
Metallurgy	0	0	0	0	0	0	0	35
Advanced Organic	0	0	0	0	0	0	0	71
Organic Preparations	0	0	0	0	0	0	0	65
Organic Problems	0	0	0	0	0	0	0	29
Advanced Physical Chemistry	0	0	0	0	0	0	0	24
Survey of Chemistry	0	0	0	0	0	0	0	6
Chemistry of Rare Elements	0	0	0	0	0	0	0	12
Chemistry of Cement	0	0	0	0	0	0	0	6
Sanitary Chemistry	0	0	0	0	0	0	0	12
Inorganic Preparations	0	0	0	0	0	0	0	18
Chemistry of Explosives	0	0	0	0	0	0	0	6
Chemistry Problems	0	0	0	0	0	0	0	12

Note: Some of the courses that seem to appear for the first time in 1930 actually appeared earlier and were then included under more general titles, such as Industrial Chemistry, which developed rapidly after 1900 into a number of specialized courses such as those dealing with fuel, foods, oil, explosives, cement, etc. These are listed in this expanded form to show the wide variety of courses listed in 1930.

According to this Table 83 per cent of the 6 colleges listed in 1870 offered a course in General Chemistry; 78 per cent of the 9 colleges in 1880; and so on.

The same forces that brought about the appointment and the final report of the Committee on Sciences of the Commission on the Reorganization of Secondary Education, 1920, caused the college authorities to shift their offerings to meet the new demands. This committee endorsed the general science course and regarding chemistry recommended general chemistry and specialized chemistry for various curricula such as household chemistry, industrial chemistry, etc. A parallel movement is also revealed in the accompanying table, for instance, household chemistry came to be supplemented by such courses as food analysis and sanitary chemistry, and

industrial chemistry came to include many practical phases. This shows the response to the demand for training for the differentiated branches taught in secondary schools.

Another force that hastened these changes was Dr. Frederick J. Kelly's study of the liberal arts colleges. He called attention to the need for definite aims and made some suggestions which, in some cases at least, appear to have stimulated and served as guides in the selection of additional courses.

It is also to be noted that since 1910 a lessening amount of time is devoted to the laboratory and more to demonstration work, while the disciplinary aim is rapidly giving place to a practical aim based on the demands of the individual student and the community in which he lives. Courses dealing with foods, cement, or explosives are good examples of this.

The historic trends in the treatment of chemistry as a school subject indicate that the present decade will witness an expansion in the college chemistry curricula along three lines; first, by the introduction of those higher courses designed specifically for those who are to become technical and research chemists; second, by the introduction of those utilitarian and vocational courses essential to the welfare of particular vocational groups; and third, by the introduction of general cultural courses in chemistry designed primarily for those neither continuing work in chemistry nor employing it in their vocations but to whom a knowledge of chemistry may furnish a means of avocational enjoyment.

THE FACTORS THAT AFFECT TEACHING SUCCESS

BY

WALTER S. MONROE

Bureau of Educational Research, University of Illinois, Urbana

ABSTRACT

The most direct method of determining the factors that contribute to teaching success is to select a group of excellent teachers and a group of poor teachers and then to endeavor to identify the teacher traits and instructional procedures that distinguish the successful teacher from the unsuccessful ones. This method has been employed by Barr who found significant differences for three traits and thirteen instructional procedures. The score cards devised for rating teachers consist of phrases or other expressions that are intended to designate the significant characteristics of classroom instruction. Hence, an analysis of teacher rating scales might be expected to yield a consensus of opinion in regard to the more significant factors of teaching success; but variations in phraseology make this approach of doubtful value. A more direct concensus of opinion relative to teacher traits was secured by Charters and Waples in the Commonwealth Teacher Training Study, completed in 1929. Their final list includes twenty-five items ranked in order of importance with respect to five types of schools.

On the basis of these investigations it appears that professional training, or rather the application of certain principles taught in professional courses, and certain personal qualities are important causes of teaching success. The evidence with respect to academic training and general intelligence probably should be considered negative.

There are also a number of correlation studies which should be considered with respect to the identification of the factors that contribute to teaching success. The correlations between intelligence test scores and measures of teaching success are low, several of them being approximately zero. These findings have been interpreted as meaning that general intelligence makes a very minor or even a negligible contribution to the quality of teaching. This interpretation probably is not justified. It is not unlikely that the low correlations are due largely to poor measures of teaching success. Furthermore, the range of intelligence in these studies is limited to that of college or normal school graduates who become teachers. This selection of the population with reference to intelligence results in "partialling out" a large portion of its influence. Hence the calculated coefficient of correlation is for only the portion of intelligence in excess of the minimum of the group. Since the data are for graduates of teacher training institutions who secured positions as teachers, this minimum approximates the mean of adult intelligence. Consequently, the factor dealt with should be labeled "intelligence in excess of the mean adult level." It is not unreasonable that the contribution of this factor should be relatively small for teaching below the college level. The total contribution of intelligence, both direct and indirect, is undoubtedly much larger. When we consider correlation studies of professional training and academic achievement it is necessary to bear in mind that measures of these factors probably include general intelligence as a large element. When allowance is made for this the correlation studies indicate that professional training makes a relatively large contribution to teaching success. The evidence with reference to academic training indicates that its contribution is somewhat less than that of professional training. The investigations examined relate

to teachers below the college level and for such teachers a possible explanation is that the subjects which a student pursues during his course of training are not very closely related to those that he teaches. Hence, it is not unreasonable that knowledge of subject matter resulting from advanced study in a teaching field makes a minor contribution to teaching success in the elementary school or even in the high school.

INFLUENCE OF SOCIAL AND EMOTIONAL ATTITUDES ON THE MENTAL CURVE OF ADOLESCENTS

BY
RALPH W. PRINGLE
Illinois State Normal University

Under the influence of G. Stanley Hall and his disciples, students of secondary education assumed that at adolescence there is an abrupt physical development followed by a marvellous mental and emotional unfolding, an intense critical activity, a new love of nature, and an amazing assimilation of wisdom; that is, "the mind at times grows in leaps and bounds," defying all analysis and explanation. But during the past fifteen years, all writers on adolescence have begun by asserting their disbelief in the abandoned saltatory theory, then they proceeded to prove by tables and graphs the untenability of the theory, especially as relates to a sudden change in the rate of growth of the *specific* mental powers. Why this anxiety over an abandoned theory?

Do the statistical tables and graphs tell the whole truth when the attitudes characteristic of adolescence are not called into action? When only paper-and-pencil tests are applied, we are not dealing with pupils as going concerns. Tests were given to the same group of children over a period of years by Baldwin and Stecher[1], Wolley[2], Thorndike[3], and Brooks[4]. Then Brooks brought together the results of many studies with a view to securing greater reliability. By putting these laboratory data together, all we get in defense of the discredited belief is that there is a slight increase in the mental growth rate between thirteen and fourteen.

But what of it? The results are not impressive for any one who has lived face to face in social relations with preadolescent and adolescent groups. Any one who has had this privilege knows that the mental reactions of a face-to-face adolescent group are quantitatively and qualitatively different from those of the preadolescent group. He knows this with the same certainty as he knows any other social phenomenon that occurs under immediate observation. Since the advent of our much objective testing and measuring, the traits and developments most characteristic of adolescence have received little attention, for the reason that there seem to be inherent obstacles that block the measuring of these traits and developments. Youth cannot be defined in terms of any isolated entity but only in terms that include the interaction between the individual and his group. We are interested in the responses of the whole situation, which is a complex stimulus-pattern. The responses are configural and do not readily yield to objective measuring. Hence this study suffers because objective varifiable facts are not available to any large extent.

P. F. Furfey[5] made an effort to measure the changing volitional life of 982 boys from eight to eighteen. He named the element under consideration "developmental age." The results, as tabulated and charted, portray "the progressively increasing and non-intellectual maturity of general behavior." The change in personality is due to "some combination of extrinsic and intrisic causes." The extrinsic causes of course include the social heritage, which begins to be appreciated during adolescence. Furfey found

that the scores increase regularly during preadolescence, that the curve turns upward more sharply from twelve to sixteen, and that after sixteen there is no tendency to increase. The significance of these findings lies in the increase during early adolescence and in the fact that the developmental age does not correlate closely with the physiological age. The full report of Furfey's study indicates that it is in social situations that the adolescent comes nearest to unifying and integrating all his responses.

One of the assumptions in the use of the various tests has been that any kind of ability is directly proportional to the performance resulting from the use of that ability; whereas in the interest of scientific accuracy, we should add that any form of active psychic energy is always conditioned by other concurrent physical and psychical forces, forces that in this case defy definite measurement. That is, mental energy, the results of which we think we can measure, is definitely conditioned by causally related social and emotional impulses.

In this discussion we seem to be justified in reasoning from physical causes to psychical effects. The maturation of the endocrine glands furnishes the physical basis for many of the psychic changes that are characteristic of adolescent development. What then are the social and emotional attitudes and responses that have their origin in glandular maturation? They are well known to observers of boys and girls in their teens; they are gregariousness, a new interest of boys and girls in each other, independence and self-assertion, a desire to cooperate and do team-work (group loyality), a desire for social approval, and other alter-centric proclivities. Thus we must not leave out of our reckoning the new functioning of the endocrine glands, which supplies the internal stimulus and increases the emotional and social tension. Mental tests do not provide the conditions which stimulate unified emotionally toned responses; the attitudes and drives involved are shunted out of the circuit; in other words, they are not part of the configuration.

Our conclusion is that any test which tests a single function fails to recognize the principle that the whole determines the functioning of any of its parts, that the functioning of the whole cannot be determined by any of its parts, that the functioning of the whole cannot be determined by even the most accurate knowledge concerning the functioning of all the parts, and that consequently there emerges from the functioning of the whole new results, new entities. However, none of the foregoing leads to the conclusion that there arises any new mental powers during adolescence; but we must conclude that there comes a new mode of functioning which appears as more critical judgments and greater ability to deal with abstract situations and think in a broader way. Moreover, when the group is confronted day after day with the same kind of social stimulus, there is a constant and progressive *growth* in the direction of ability to respond to social interstimulation; that is, there is a gradual *building up* of social response habits which no purely mental test can reach. Thus the final conclusion is that it is arbitrary and unscientific to *separate* the purely mental aspects of the adolescent, proceed to measure and chart our findings, then conclude that we have obtained practical results that will aid us in better understanding and sympathetically dealing with classroom situations.

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[1] Baldwin, B. T., and Stecher, L. I., "Mental Growth Curve of Normal and Superior Children." University of Iowa Studies in Child Welfare, Vol. II, No. 1.

[2] Data collected at Cincinnati, Ohio, not published in full.

[3] Thorndike, E. L., "On the Improvement of Intelligence Scores from Fourteen to Eighteen", Journal of Educational Psychology, Vol. XIV.

[4] Brooks, F. D., The Psychology of Adolescence, Houghton Mifflin Company, 1929.

[5] Furfey, Paul H., "Child Development", June, 1931.

WHO SHOULD GO TO COLLEGE?

BY

JESSE E. THOMAS

Illinois Wesleyan University, Bloomington, Illinois

ABSTRACT

With approximately 2.5 per cent of the total school population of over thirty-five million in the twelfth grades of our high schools, a large body of prospective college freshmen is available each year to the colleges and universities of the country. There are about 35,000 pupils in the twelfth grades of Illinois public and private secondary schools. The same condition exists in most other states. These prospective students are not only being turned out by the high schools, but they are also going to colleges and universities. The enrollment in higher institutions increased 65.9 per cent from 1920 to 1926 and 8.8 per cent from 1926 to 1928. These increases have continued for almost every type of higher education.

It can be said without fear of contradiction that higher education has become an established part of American life, a part which will have a great deal of influence on the social and economic trends of the future. It is fitting, then, that the question: Who Should Go To College? receive careful consideration.

There are three points of view from which one may consider this problem. In the first place, there are certain personal considerations which cannot be overlooked. Completing a college curriculum usually takes four years of the average student's time. Can the student afford to spend this time in college? This is a personal question which every student must answer for himself. There are some tests which he may apply to aid him in answering this question. If he has sufficient social maturity to enable him to adjust himself to new social situations without difficulty, and if he has sufficient mental maturity to enable him to handle the work on this level, the only other thing which he must have is a determination to succeed, a thing which is often lacking in the present generation of college students, many of whom do not "come to college" but are "sent to college" by a parent who thinks it is the best thing for them to do.

It is quite probable, however, that even those who never complete a college curriculum gain something from their years spent on a college or university campus. It probably does no harm for one to have his outlook on life broadened by a year or two spent at some college.

It is possible to suggest certain types of individuals who may always be expected to get along well in college as well as types who can not be expected to succeed. Students with exceptional mental ability usually succeed; those with superior mental ability, ambition and seriousness of purpose may be expected to succeed. The best of those with good mental ability who have not yet found themselves may confidently look forward to acquiring definiteness of purpose sufficient to carry them successfully through their college curriculum. Of course, those who do not have these things, together with the physically unfit and the financially poor student, may expect a great deal of difficulty on the road to a higher education.

In the second place, there are certain social aspects of this problem which should be considered. Few students pay the cost of their education, either in private or public institution. For this reason, if for no other,

the social group should be concerned about the education of its members. If the objectives of college training are in harmony with the aims of society, it would seem that all normal young people might profit from being in college. This does not mean that all so-called normal people would succeed in completing any college curriculum as it is now organized. It simply means that college experiences might well be made profitable to all normal young people.

Since society has sanctioned higher education to such a high degree, as is evidenced by the recognition which is given to college attendance in a great many ways, it seems that in such a society as ours it is almost necessary to make such education available to all those who can profit, either individually or socially, from it.

In the third place, we may consider the problem from a very practical standpoint of selection of those who shall come to our own individual colleges. Most of us are probably vitally interested in this phase of the problem. The usual procedure for selecting college freshmen, of course, is to take those whose principles say are in the upper fifty or seventy-five per cent of their class, which means practically nothing so far as ability or habit are concerned, and then give them certain almost meaningless placement examinations, meaningless because we do nothing with them after they are given. In reality, most Illinois colleges and universities take all who come to them (they even go out after them with all types of inducement except money payments) and try to make college students out of pupils who never had anything in high school which they succeeded in passing with a higher mark than "D" (whatever that means). The colleges then carry these people on through a curriculum often intended for a civilization long since extinct and turn them out at the end of four or five years into a society that has moved on so far during the four or five years they have been in college that they can no longer find their places in it.

Together with the question of: Who should go to college? must go the question of: To What Kind of a College Should Anyone Go? In summary let me say that anyone who is desirous of more education and who is capable and willing to pay the price, either in effort or in money, should be able to secure that education. Society should supply, and I believe it has supplied either publicly or privately, such an opportunity to all who can take advantage of it. However, society is undergoing great changes at the present time, and the old fashioned college, frequently hardly out of the Middle Age period, will no longer adequately meet the needs of young people. There must be an increased tendency on the part of institutions of higher learning to experiment with new curricula, new methods of teaching, and, in fact, with the creation of a new social order. Some colleges have done this; others are doing it; and every college whch is to serve a real function in our changing American civilization must dare to do a great deal of pioneering or go out of business.

PAPERS IN ZOOLOGY

Extract From the Report of the Section Chairman

Of the six papers on the Zoology Section program, four were presented in the section meeting; only one is published herein.

The following two papers were read by title only:

"The habits of Ichneumon flies," by W V. Balduf, University of Illinois.

"The aquatic Isopods or Asellidae of Illinois," by H. H. Ross, Illinois State Natural History Survey, Urbana.

The article "Recent advances in studies of the testicular hormone," by T. F. Gallagher and F. C. Koch, University of Chicago, was not presented for publication.

The following two papers were withdrawn from publication:

"An ecological survey of the mammals of the Chicago area," by E. V. Komarek and D. A. Spencer, The Chicago Academy of Sciences and the University of Chicago.

"An ecological study of the birds and mammals of the Louisiana coastal plain," E. V. Komarek, Chicago Academy of Sciences and the University of Chicago.

The attendance at the section meeting averaged twenty; maximum attendance was twenty-two.

Dr. William Hays, Department of Entomology, University of Illinois, was elected chairman of the Zoology Section for 1932-1933.

(Signed) F. C. Hottes, *Chairman*

THE VARIATION AND DISTRIBUTION, RECENT AND FOSSIL, OF THE LAND SNAIL *POLYGYRA PROFUNDA* SAY, IN ILLINOIS*

BY

FRANK C. BAKER

University of Illinois, Urbana

ABSTRACT

Polygyra profunda in the recent fauna has a large shell with an almost round aperture. In Pleistocene time a race lived which averaged smaller than the recent form and which had a more elongated aperture, especially when viewed from the front of the shell. The average index (shown by fifteen graphs of recent and fossil species from several localities) of each is shown below.

	Greater Diameter	Height of aperture	Altitude of aperture
Recent	25.7 mm	9.6 mm	7 mm.
Fossil	22.2 mm	7.6 mm	5.5 mm.

The Pleistocene race has been differentiated as variety *pleistocenica* F. C. Baker and occurs in deposits of Sangamon, Peorian, and the Shelbyville age in Illinois, the localities being near or bordering Mississippi River. The race also lived in Iowa during Peorian time. Typical *P. profunda* is distributed geographically throughout northern Illinois only but its distribution in the United States ranges as far south as Kentucky, North Carolina, and northern Alabama. During Pleistocene time, however, *P. profunda* is known to have been distributed as far south as Missouri and southern Mississippi. In Illinois the fossil form was abundant as far south as Union County. This difference in the geographical distribution in recent and Pleistocene time indicates an extension of the species in the Mississippi Valley of about 600 miles south of the present Illinois range and about 300 miles south of the Kentucky localities.

*To be published in full in American Midland Naturalist, Vol. 15, 1934.

Stub for T. P.

TRANSACTIONS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

VOL. 26 SEPTEMBER, 1933 NUMBER 1

Announcement
Twenty-seventh Annual Meeting

Officers and Committees, General Program
Section Meetings, Junior Section
Instructions to Authors
General Information

Friday and Saturday, May 4-5, 1934
Decatur, Illinois

Department of Registration and Education
State Museum Division, Centennial Building
Springfield, Illinois

Entered as second-class matter, December 6, 1930, at the post office at Springfield, Illinois, under Act of August 24, 1912.

OFFICERS AND COMMITTEES
For 1933-1934

President, B. SMITH HOPKINS, University of Illinois, Urbana.
First Vice-President, CHARLES H. BEHRE, JR., Northwestern University, Evanston.
Second Vice-President, J. H. RANSOM, Millikin University, Decatur.
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Treasurer, GEORGE D. FULLER, University of Chicago, Chicago.
Librarian, ARTHUR S. COGGESHALL, State Museum, Springfield.
Editor, DOROTHY E. ROSE, State Geological Survey, Urbana.
The Council is composed of the President, First and Second Vice-Presidents, Secretary, Treasurer, Librarian, and the last two retiring Presidents.

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L. K. WRIGHT, Bloomington High School, Bloomington, (Biology).
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WILLIS T. MAAS, Dupo High School, Dupo, (Geology).
D. L. BARR, J. Sterling Morton High School, Cicero, (Physics).
MARY BROCK, Decatur High School, Decatur, (Local Arrangements).
CHARLOTTE MEYER, Decatur High School, Decatur, (Local Arrangements).
ROSALIE M. PARR, University of Illinois, Urbana (University Representative).
LYELL J. THOMAS, University of Illinois, Urbana, (University Representative).

Committee on Publications:
The President, the Secretary, and LYELL J. THOMAS, University of Illinois, Urbana.

NEW YORK
BOTANICAL

Committee on State Hall of Fame:
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WILLIAM A. NOYES, University of Illinois, Urbana.
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Delegate to the American Association for the Advancement of Science:
A. C. WALTON, Knox College, Galesburg.

Delegate to the Conservation Council of Chicago:
V. O. GRAHAM, 4028 Grace Street, Chicago.

GENERAL PROGRAM

All Addresses and Section Meetings Are Open to the Public

THURSDAY, MAY 3

7:30 p. m. Meeting of the Council *(Room 119, James Millikin University).*

FRIDAY, MAY 4

8:00 a. m. Registration by all members and guests. Secure tickets for luncheon at Aston Hall and for the annual banquet at First Presbyterian Church. Register for Saturday field trips *(Lobby of James Millikin University).*

8:00 a. m. Meeting of the Council with local committee and delegates from affiliated societies *(Room 119).*

8:30 a. m. Preliminary business meeting of the Academy. Appointment of committees on nominations and on resolutions; adjournment until 11:45. *(Chapel.)*

9:00 a. m. Address of the retiring president—*Recent Developments in the Chemistry of the Rare Earth Group*—B. SMITH HOPKINS, University of Illinois.

9:40 a. m. Symposium: Conservation of Illinois agricultural and human resources. Addresses to members of the Academy and students of James Millikin University:

The Significance of the Conservation of Land Resources—H. W. MUMFORD, Dean of the College of Agriculture, University of Illinois.

The Relationship Between the Standard of Living and Natural Resources—SIMON LITMAN, Professor of Economics, University of Illinois, Urbana.

10:30 a. m. Addresses to members of the Academy:

Classification of Illinois Lands—RAYMOND S. SMITH, Professor of Soil Physics, University of Illinois, Urbana.

Soil Erosion Control Projects—F. A. FISHER, Soil Erosion Service, U. S. Department of the Interior.

Utilization of Illinois Lands for Forestry, Wildlife, and Recreation—T. H. FRISON, Chief, State Natural History Survey, Urbana.

Objectives of the Illinois Planning Commission—COLONEL H. L. KELLOGG, State Planning Commission, Springfield.

11:45 a. m. Annual business meeting of the Academy. Reports of officers and committees; other business; adjournment until 5:00 p. m.

12:00-1:00 p. m. Luncheon, Aston Hall *(Women's Dormitory)*, 40 cents.

1:00 p. m. Visit to Library of James Millikin University.

1:45 p. m. Section meetings. Election of section chairmen for 1934-35; papers, demonstrations, discussions *(James Millikin University).*

5:00 p. m. Final business meeting of the Academy *(Chapel).* Reports of committees; election of officers for 1934-35; appointments to standing committees; other business; adjournment.

7:00 p. m. Annual banquet (informal), *(First Presbyterian Church).* Reservations should be made in advance by mail to J. H. Ransom, 1357 W. Wood Street, Decatur, and tickets secured at time of registration. $1.00 per plate.

7:45 p. m. Annual public lectures *(First Presbyterian Church).*
Address of Welcome—O. W. SMITH, Mayor, Decatur.
Address—JESSE H. WHITE, President, James Millikin University.
Response—B. SMITH HOPKINS, President, Illinois State Academy of Science.
A Three-Year Windjammer Cruise to the Islands of the South Atlantic—GEORGE FINLAY SIMMONS, University of Chicago, Chicago.

SATURDAY, MAY 5

8:00 a. m. Meeting of the new Council *(Room 119, James Millikin University).*

9:00 a. m. Inspection trips leave from James Millikin University. The local committee will arrange for transportation for those having no cars if reservations are made in advance. Register for trips at the time of the general registration.

Industrial trip—a visit to the Decatur Sewage Disposal Works and the Water Purification Plant; trip through the Staley Starch Factory. To be conducted by William D. Hatfield and R. E. Greenfield.

Geological trip—a visit to observe the Shelbyville moraine, the buried Sangamon soil, the Wisconsin valley-train, Wisconsin loess, intraglacial gravels in the Shelbyville drift along Sangamon River valley, and relations of the Shelbyville moraine to the older Illinoian drift plain to the west. The trip will be under the direction of M. M. Leighton, Chief, Illinois State Geological Survey, and will require the morning and early part of the afternoon.

Coal Mine trip—a trip through the coal mine in the City of Decatur. To be conducted by D. W. Beggs and G. H. Cady.

PROGRAM OF SECTION MEETINGS

FRIDAY, MAY 4—1:45 P. M.

JAMES MILLIKIN UNIVERSITY

AGRICULTURE

H. W. Mumford, University of Illinois, *Chairman*

The Agriculture section is joint sponsor with the Economics section of the Symposium presented at the morning general session, and will not hold a separate section meeting.

ANTHROPOLOGY

Room 119

Thorne Deuel, University of Chicago, *Chairman*

Election of chairman for 1934-35.

Symposium: Certain Aspects of Mississippi Valley Archaeology and Their Relation to Illinois.

1. Prehistoric timetables (lantern slides)—John Voss, Peoria.
2. Certain bluff mounds in Western Jersey County, Illinois—P. F. Titterington, St. Louis, Missouri.
3. Certain Carolina sites and their affiliations, northern and southern—J. D. Jennings, University of Chicago, Chicago.
4. Physical types in aboriginal Illinois—George K. Neumann, University of Chicago, Chicago.
5. Basic cultures of the Mississippi Valley and their Illinois representatives—Thorne Deuel, University of Chicago, Chicago.
6. Archaeological reconnaissance work in southern Illinois, 1933—Bruce W. Merwin, Southern Illinois State Normal University, Carbondale.
7. The tree-ring method of chronology and its application in Illinois—J. H. MacGregor, Museum of Northern Arizona, Flagstaff, Arizona.

BOTANY

Room 215, Main Stairway

E. L. Stover, Eastern Illinois State Teachers College, *Chairman*

Election of chairman for 1934-35.

1. New methods in paleobotanical micro-technique (lantern slides)—A. C. Noé, University of Chicago and Illinois State Geological Survey.
2. Rock ledge vegetation in southern Illinois (lantern slides)—A. G. Vestal, University of Illinois, Urbana.
3. Mosses from the Illinois Ozarks—Stella M. Hague, University of Illinois, Urbana.
4. Some Bryophytes from Macon County, Illinois—Gladys C. Galligar, University of Illinois, Urbana.
5. Barberry eradication in Illinois (lantern slides)—Robert W. Bills, United States Department of Agriculture, Bureau of Plant Industry.
6. A Stratigraphical study of the Manito Swamp (lantern slides)—John Voss, Manual Training High School, Peoria.

CHEMISTRY

Room 240, West Stairway

FRED A. DYKINS, Division of Highways, Springfield, *Chairman*

Election of chairman for 1934-35.

1. The use of ceric sulphate for the determination of cuprous oxide obtained by the action of reducing sugars on Fehling's solution—D. T. ENGLIS with R. A. STEGEMAN, University of Illinois, Urbana.
2. A few suggestions on the teaching of fuels in elementary chemistry—G. T. FRANKLIN, Lane Technical High School, Chicago.
3. Some metathetic reactions of iodine mono-chloride—H. W. HORRABIN, Western Illinois State Teachers College, Macomb.
4. The occurrence of a pectin material in artichoke syrup—D. T. ENGLIS with H. A. HARRISON, University of Illinois, Urbana.
5. Micro-methods in qualitative analysis—J. H. REEDY, University of Illinois, Urbana.
6. Lysis and hydration of serum proteins as general features of disease—K. SCHULHOF, Chicago.
7. A new method for whipping cream—G. F. SMITH with C. A. GETZ, University of Illinois, Urbana.
8. The effect of potassium cyanide upon amylase activity—D. T. ENGLIS, with J. O. PAGE, University of Illinois, Urbana.
9. The mechanism and application of the Fries isomerization—V. C. SEKERA, Northwestern University, Evanston.
10. The explosive reaction of perchloric acid with bismuth—D. G. NICHOLSON with J. H. REEDY, University of Illinois, Urbana.

ECONOMICS

ERNEST F. BOGART, University of Illinois, *Advisory Member*

The Economics section is joint sponsor with the Agriculture section of the Symposium presented at the morning general session, and will not hold a separate section meeting.

GEOGRAPHY

Room 116, West End Corridor

ALFRED W. KASEL, Moline High School, *Chairman*

Election of chairman for 1934-35.

1. Decatur, Illinois, a study in urban geography—E. MURIEL POGGI, University of Illinois, Urbana.
2. Points of emphasis in the geography of Illinois (lantern slides)—W. O. BLANCHARD, University of Illinois, Urbana.
3. Growing broomcorn in Coles County, Illinois (lantern slides)—ROSE ZELLER, Eastern Illinois State Teachers College, Charleston.
4. The relation of topography and drainage to farm-type regions of Illinois—WILLIAM E. POWERS and EDWARD C. DAPPLES, Northwestern University, Evanston.
5. The southern Wisconsin tobacco region (lantern slides)—H. O. Lathrop, Illinois State Normal University, Normal.
6. Items in the Haitian pattern of occupance—R. S. PLATT, University of Chicago, Chicago.
7. Patterns of the port of Vancouver, British Columbia—LEAH STEVENS, Eastern Illinois State Teachers College, Charleston.
8. The retarded development of Alaska—EMMA AYRS, Northwestern University, Evanston.

GEOLOGY

Room 221, Main Stairway

CHARLES H. BEHRE, JR., Northwestern University, *Chairman*

Election of chairman for 1934-35.

1. Subsurface stratigraphy of the Devonian of western Illinois—L. E. WORKMAN, Illinois State Geological Survey, and JOHN HUNER JR., University of Illinois, Urbana, (5 minutes, lantern slides).
2. On the reproductive habits of *Turritella alumensis* Mansfield—A. H. SUTTON, University of Illinois, Urbana, (8 minutes).
3. The age of the so-called Permian beds near Danville, Illinois—H. R. WANLESS, University of Illinois and Illinois State Geological Survey, Urbana, (10 minutes).
4. Research on Paleozoic formations in Virginia—ARTHUR BEVAN, Virginia State Geological Survey, (to be read by title).

5. The Port Byron (Guelph) fauna in Illinois—T. E. Savage, University of Illinois, Urbana, (8 minutes, lantern slides).
6. The subsurface stratigraphy of the Decatur region—L. E. Workman, Illinois State Geological Survey, Urbana, (12 minutes, lantern slides).
7. The glaciology of the Decatur region—M. M. Leighton, Illinois State Geological Survey, Urbana, (12 minutes, lantern slides).
8. Effects of barometric pressure and winds on the level of Lake Michigan—W. E. Powers, Northwestern University, Evanston, (12 minutes, lantern slides).
9. Boundaries of Pennsylvanian cyclothems—J. M. Weller, Illinois State Geological Survey, Urbana, (10 minutes, lantern slides).
10. New American plants from the Pennsylvanian period as preserved in coal balls—A. C. Noé, University of Chicago, Chicago, and Illinois State Geological Survey, Urbana, (10 minutes, lantern slides).
11. The gelogical and biological significance of coal beds—L. C. McCabe, Illinois State Geological Survey, Urbana, (10 minutes, lantern slides).
12. The integration of sciences required for logical study of coal constitution—Gilbert Thiessen, Illinois State Geological Survey, Urbana, (12 minutes, lantern slides).
13. Clay veins in the Springfield (No. 5) coal—W. B. Roe, Northwestern University, Evanston, (10 minutes, lantern slides).
14. Migmatization in the Sawatch Range, Colorado—J. T. Stark, Northwestern University, Evanston, (12 minutes, lantern slides).
15. Rock wool, an Illinois resource—J. E. Lamar, Illinois State Geological Survey, Urbana, (10 minutes, lantern slides).
16. Structural control of ore deposition in the Wisconsin-Illinois lead-zinc district—E. R. Scott and C. H. Behre, Jr., Northwestern University, Evanston, (10 minutes, lantern slides).
17. Silurian Echinoids—Paul H. Dunn, University of Chicago, Chicago, (5 minutes, lantern slides).
18. A four-hundred acre lake disappears—Clarence Bonnell, Harrisburg Township High School, Harrisburg, (5 minutes).

MEDICINE AND PUBLIC HEALTH

Harry F. Ferguson, State Department of Public Health, Springfield, *Advisory Member*

No program has been planned for this section for the 1934 meeting.

PHYSICS

Physics Lecture Room, Main Stairway

Jakob Kunz, University of Illinois, *Chairman*

Election of chairman for 1934-35.

1. A compact vacuum gauge for measuring pressures ranging from .2 mm. down to .0001 mm. of mercury—Charles T. Knipp, University of Illinois, Urbana, (demonstration, 10 minutes).
2. Renewed activity of radium bromide after heating as revealed in a Wilson Expansion Chamber—Charles T. Knipp, University of Illinois, Urbana, (demonstration, 10 minutes).
3. Model of a storage cell, simulating ion and electron flow—Charles T. Knipp, University of Illinois, (demonstration, 10 minutes).
4. Electron oscillations—J. T. Tykociner and A. E. Abel, University of Illinois, Urbana.
5. The flow through submerged orifices—Jakob Kunz, University of Illinois, Urbana.
6. Electron diffraction and the physics of solids—Lester I. Bockstahler, Northwestern University, Evanston.
7. The present crisis in theoretical physics—Jacob Kunz, University of Illinois, Urbana.

PSYCOLOGY AND EDUCATION

Room 237, West Stairway

Ralph W. Pringle, University High School, Normal, *Chairman*

Election of chairman for 1934-35.

1. Cultural value of courses in psychology and education—George D. Wham, Southern Illinois State Normal University, Carbondale.
2. Contributions of psychology to education—E. H. Cameron, University of Illinois, Urbana.

3. Psychology and juvenile crime—M. L. Reymert, Mooseheart Laboratory, Mooseheart.
4. Psychiatry and the modern child—Paul L. Schroeder, Institute for Juvenile Research, Chicago.
5. Education and the present reorganization of life—Jordan Caven, Rockford College, Rockford.
6. A study of certain rural teacher activities and the adequacy of training for performance—Ted Ragdale, Southern Illinois State Normal University, Carbondale.
7. Relation of scholarship during college career to success in teaching as judged by salary—H. A. Peterson, Illinois State Normal University, Normal.
8. Out of school activities that contribute to professional success of the teacher—B. W. Merwin, Southern Illinois State Normal University, Normal.

ZOOLOGY

Room 235, West Stairway

W. C. Spooner, Eastern Illinois State Teachers College, *Chairman*

Election of chairman for 1934-35.

1. Animals killed by automobiles on Illinois highways—W. P. Flint, Illinois State Natural History Survey, Urbana.
2. Thomas Say, early American zoologist of the middle west—H. W. Mauntel, Mendota High School, Mendota.
3. Notes on the environmental relations of the crayfish *Cambarus propinquus* Girard—W. C. Vandeventer, University of Illinois, Urbana.
4. Winter habits of land snails on a Sangamon River floodplain—T. D. Foster, University of Illinois, Urbana.
5. Abnormalities in the uterine young of the snail *Campeloma rufum*—N. T. Mattox, University of Illinois, Urbana.
6. A study of characters for the differentiation of two species of minnows of the genus *Notropis*—W. C. Starrett, University of Illinois, Urbana.
7. Seasonal life history of a snail of the genus *Fossaria*—H. J. Van Cleave, University of Illinois, Urbana.
8. Swimming of the muskrat—J. D. Mizelle, University of Illinois, Urbana.
9. Skeletal modifications in river catfishes of Illinois—W. F. Hoheisel, University of Illinois, Urbana.
10. The changing states of some Illinois birds—C. W. G. Eifrig, Concordia Teachers' College.
11. The Florida Gallinule—C. K. Carpenter, Morgan Park.
12. Sexuality in the Prosobranch mollusks—C. L. Furrow, Knox College, Galesburg.
13. Entomophagus parasitism among beetles—W. V. Balduf, University of Illinois, Urbana.
14. Biological principles underlying the field of education—C. E. Montgomery, Northern Illinois Teachers College, DeKalb.
15. Changes in abundance of birds in the Chicago area during the past twenty-five years—C. B. Coursen, General Biological Supply House, Chicago.
16. Living vs. Dead—Sister M. Stanislaus, Mercy High School, Milwaukee, Wisconsin.
17. An ecological study of rapids communities—H. E. Gearhart, Grand Tower, Illinois.
18. Observations on the stream life of the Charleston, Illinois, region with notes on the food ecology of fishes—T. L. Hankinson, Michigan State Normal College.
19. Moth proofing and moth proof materials—C. L. Metcalf, University of Illinois, Urbana.

ILLINOIS STATE ACADEMY OF SCIENCE

JUNIOR SECTION

HIGH SCHOOL SCIENCE AND CLUBS

Louis A. Astell, 137 N. Evergreen Avenue, Kankakee, *Chairman*

Mary Brock, Decatur High School; Charlotte Meyer, Decatur High School
in charge of local arrangements

FRIDAY, MAY 4

8:00 a. m. Registration *(James Millikin University, East Corridor, first floor).*

8:00-11:00 a. m. Arrangement of exhibits. *(East Corridor, Rooms 100 and 103.)* Scientific equipment exhibited by scientific companies.

12:00 m. Luncheon, *(Westminster Church, two blocks west of University)*, 35 cents.
12:45 p. m. Visit to James Millikin University Library.
1:30 p. m. Annual business meeting of official delegates of Junior Section *(James Millikin University Chapel)*.
Formal initiation of new clubs.
Geological Adventures—T. T. QUIRKE, University of Illinois, Urbana.
Sound films: (1) *The Molecular Theory of Matter;*
(2) *Oxidation and Reduction.*
Talks and demonstrations by student delegates.
3:45 p. m. Presentation of awards. B. SMITH HOPKINS, President, Illinois State Academy of Science.
6:30 p. m. Annual banquet, First Presbyterian Church, 65 cents.
7:45 p. m. Address.

SATURDAY, MAY 5

9:00 a. m. Choice of inspection trips as listed under general program.

INSTRUCTIONS TO AUTHORS OF PAPERS PRESENTED AT SECTION MEETINGS

Summaries suitable for publication and not longer than 500 words should be handed to the section chairman at the time of the section meetings. The reduced State appropriation for the publication of the *Transactions* this year will make it impossible to publish longer articles or illustrations.

HEADQUARTERS OF THE ACADEMY

JAMES MILLIKIN UNIVERSITY
DECATUR, ILLINOIS

Registration Desk in Lobby

Telegrams and other messages may be sent to individuals in care of J. H. Ransom, James Millikin University, Decatur, Illinois, and called for at the registration desk.

Changes of schedule or program and other special announcements will be posted in the lobby at the registration desk.

Secure tickets for banquets and register for trips at the registration desk.

Members and guests of the Academy expecting to attend the Annual informal Banquet and the Luncheon at Aston Hall, Friday noon, May 4th, are asked to notify the Local Chairman previous to May 4th.

Junior Section Headquarters: East Corridor, James Millikin University.

Housing facilities for out-of-town guests attending the Junior Section are being arranged as follows: For boys in the fraternity houses of James Millikin University; for girls in Aston Hall and at the sorority houses., The rate for those who can be accommodated in this way will be about 50 cents for bed and breakfast. Sponsors of science clubs wishing these accommodations should communicate before May 1st with Miss Mary Brock or Miss Charlotte Meyer, Decatur High School.

Hotel Rates

Orlando Hotel:
Single room with bath, $2.50; without bath, $2.00.
Double room with bath, $4.00; without bath, $3.50.

St. Nicholas Hotel:
Single room with bath, $2.00, $2.50; without bath, $1.50, $1.75.
Double room with bath, $2.75, $3.25; without bath, $2.25, $2.50.
Room with 2 beds for 4 people, with bath, $1.50 per person; without bath, $1.00 per person.

Ladies Entertainment, Friday, May 4

Luncheon at Aston Hall.
2:30 p. m. Drive to points of interest in and around Decatur.
4:00 p. m. Tea at home of Mrs. Jesse H. White.

TRANSACTIONS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

VOLUME 26 DECEMBER, 1933 NUMBER 2

Papers Presented in General Sessions at the Twenty-sixth Annual Meeting

Memoirs

EDITED BY DOROTHY E. ROSE

Printed by authority of the State of Illinois.
DEPARTMENT OF REGISTRATION AND EDUCATION
STATE MUSEUM DIVISION, CENTENNIAL BUILDING
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Volume 26 December, 1933 Number 2

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PAPERS PRESENTED IN GENERAL SESSIONS AT THE TWENTY-SIXTH ANNUAL MEETING, EAST ST. LOUIS

ADVANCEMENT IN THE SCIENCE OF PUBLIC HEALTH*

BY

FRANK J. JIRKA, M. D.

State Health Director, Springfield, Illinois

The public health movement is still very young. Compared in age with such institutions as the church, the monetary system and the military, public health service is at best only a youth. Like a healthy, vigorous human, the public health movement has grown rapidly during its early life.

Within the first year of life a healthy infant doubles in weight. Then he settles down to a less rapid but steady increase in height and weight until about twelve years of age. At that, as though the youngster had just seized upon a glimpse of the richness of life and the rare privileges of human existence upon the earth, he begins to grow in height and weight and in breadth of intellect and vision at a rate far beyond any previous experience since the first twelve months. During about four years of that period known as adolescence, a child grows with such amazing rapidity that his parents are taxed to the limit to keep him supplied with clothes that fit, food that meets his needs and a thousand things which are required to satisfy his expanding physical and mental horizon. It requires, furthermore, the closest observation on the part of acquaintances and friends of the family to recognize and keep informed about the changes that take place in growth and habits of an adolescent.

It appears that the public health movement is now in the midst of its adolescent growing period. During its infancy, the period prior to 1900, it suffered from inanition. Having survived that hazardous and critical period, the public health movement then settled down to a reasonably steady growth that continued until about the opening of the World War. That conflict gave a tremendous impetus to public health service. It demonstrated on a large scale the infinite possibilities of controlling disease and maintaining health through the application of scientific knowledge. Since then the growth of public health service in this country has been phenomenal. It has enjoyed a healthy adolescence, expanding and spreading out in all directions. The results have been astonishing. A study of appropriations by municipal and state legislative bodies indicates that this youthful activity may suffer somewhat from a lack of nourishment during the immediate future. It requires more than a short ration, however, to seriously discourage a robust adolescent.

An omnivorous appetite is characteristic of youth. Food in great quantities for body and mind is drawn from a multiplicity of sources if healthy development results. So it is with the public health movement. No one science and no one profession can provide this service with a program

* Read before the Twenty-sixth Annual Meeting, Illinois State Academy of Science, East St. Louis, Illinois, May 5, 1933.

worthy of the name. Indeed, public health work depends upon knowledge and skill drawn from the fields of medicine, engineering, bacteriology, epidemiology, biometry, biology, zoology, geology, psychology, psychiatry, sociology, chemistry, dentistry, eugenics, physics, nutrition, education and numerous others. Advancement in any of these fields is at least a potential advancement in the public health movement. A delineation of advancement in public health must therefore be limited to a broad vision of progress along the whole sweeping front of this significant movement. So able a scientist as Dr. H. Levy, the mathematician, declares that no scientist would claim to know all about tobacco-growing, let alone the other factors that enter into the manufacture of a cigarette. How much less would an administrator profess to know all about all of the sciences involved in public health.

The most important advancement in respect to public health is doubtless the change in popular attitude toward the meaning and significance of this movement. Only 27 years ago an impetuous president of the United States entertained grave doubts in his own mind as to whether or not he should retain as chief sanitary officer of the Panama Canal Zone a man who spent, as he had been informed, all of his time in trying to kill mosquitoes. About two weeks ago a nationally known educator (Dr. Robert K. Speers) roundly upbraided health education instructors for being too gullible in the acceptance of fads and half truths. Among these he cited "a clean tooth never decays" and "a daily bath for positive health" as examples.

These two illustrations show that within thirty years the best popular attitude has changed from skeptical to critical in respect to preventive medicine. From the mountain peaks to which he has swiftly climbed the well informed public health specialist looks back upon the valley of limited knowledge that he used as stepping stones to higher altitudes. The knowledge he used for tools then, he now recognizes were crude and simple. These tools served well their purpose, however. Now the public has reached those valleys and are already striving to climb the higher grades. This is proved by the critical attitude of mind.

The shift from skepticism to confidence in preventive medicine made possible the improvement that has taken place in the public health. It made possible appropriations to health departments and contributions to the many voluntary public health agencies throughout the country.

The next step, according to J. B. S. Haldane, is to bring about a popular attitude so that both the electorate and the lawmakers will think in terms of human biology. Popular thought today is almost wholly in economic channels. Tariff walls are built up and torn down chiefly for economic reasons. If thought were redirected into biological channels the basis for tariff and other laws would shift to human instead of monetary values. Suppose the steel industry petitioned Congress for a protective tariff. The death rate from pneumonia is much higher among steel workers, particularly those subjected to strenuous labor and radical changes in temperature, than among employes in any other industry. With this knowledge at hand the biologist-politicians would say to the steel magnates, "We cannot protect your industry until you protect more adequately the health of your employes."

Lead poisoning, silicosis, and asbestosis are three important hazards involved in various manufacturing, industrial, and commercial employment. The lawmakers who think in terms of human biology would grant no favors in the form of protective tariffs or other legal advantages to any of these industries until all reasonable precautions were taken to protect the employes. This is the next great step in the advancement of public health. The prevailing popular tendency to criticize the shortcomings of health education encourages the belief that progress is being made in that direction.

Record Keeping

Next to the change in popular attitude toward preventive medicine the next most important advance in public health service is probably the collection, classification, and utilization of records. It is an astonishing fact that reliable records of mortality, the prevalence of diseases and of births date back only to 1918 in Illinois. Prior to that time the mortality records in only 27 states were acceptable to the United States bureau of the census as reliable. Mortality records are now accepted by the bureau from all of the states except Texas and South Dakota. These records, which are constantly being more refined and accurately executed, are the very foundations upon which the public health structure is built. They show what diseases are most hazardous, what age groups fall victims most easily to this or that danger. They show the results of efforts at disease control and the gains and losses in the public health program. We know from the death records, for example, that diphtheria killed one thousand, one hundred forty-two people in Illinois during 1918 and only two hundred forty last year. We know that mortality from tuberculosis fell from 8,579 in 1918 to 4,273 in 1932. We know also that the greatest risk of diphtheria is to the child between two and five years of age while the hazard of tuberculosis is three times as great as that from all other health dangers to young women between 14 and 35 years of age.

The statistics, moreover, show that improvement in public health protection has advanced at an uneven rate from a geographical standpoint. This is true when considered on a state, national or international basis. Smallpox, typhoid fever and malaria are as prevalent and fatal as ever throughout a large portion of Mexico. Within the United States both typhoid fever and diphtheria have been practically eradicated in some commonwealths while in others these two diseases are still problems of large magnitude. Last year, for instance, typhoid fever was responsible for only 1 death or less per 100,000 people in New York, Connecticut and Wisconsin, while diphtheria was charged with less than 3 deaths per 100,000 people in California, Iowa, Massachusetts, Michigan, Minnesota, New York and Wisconsin.

In Illinois two counties last year experienced death rates from diphtheria of a magnitude comparable with those prior to the discovery of antitoxin and toxoid or toxin-antitoxin while 58 counties suffered no loss of life whatever from that disease. When grouped together the 34 counties that make up the extreme southern third of Illinois have a mortality rate from typhoid fever that is fifteen times greater than that of the 33 counties in the extreme northern third of the State. The death rate from diphtheria is three times as great, and the infant death rate is 30 per cent higher in the southern than in the northern third of this State. In the southern third the death rate from tuberculosis is 20 per cent greater than in the central third.

Statistical records bring out, moreover, that a tremendous shift is taking place in the age level of the population. At the turn of the century nearly one-half of all mortality was among children under five years old. Now less than 10 per cent of the mortality is in that age group. This means that a much larger percentage of the population is reaching maturity and the upper age levels than at any previous time in history. Fully 40 per cent of the population of Illinois are over 35 years old now whereas about 30 per cent of the people in the State had reached that age in 1900.

This aging of the population brings to the fore a host of problems. Instead of diarrhea, diphtheria, typhoid fever, tuberculosis and other hazards of infancy, childhood and early maturity, such health risks as cancer, heart disease, diabetes and nephritis dominate the picture. In addition to this, industry, commerce, and the government find themselves with an increasingly large percentage of leaders who have reached three score years of age. Al-

though still physically vigorous and mentally alert these men experience great difficulty in adjusting their point of view to the swiftly changing conditions brought about by scientific development. The records at least make us aware of a problem that grows daily in complexity and magnitude.

Sickness records have likewise marked an important advance in public health service. Not only are case reports required for a constantly increasing number of diseases but sickness surveys have brought to light some astonishing knowledge. No one suspected until recently, for instance, that chronic rheumatism is the greatest single cause of all chronic illness. This opinion is based upon a study of one per cent of the population of Massachusetts which indicated that fully 145,000 people are suffering from chronic rheumatism at any one time in that state. The Committee on the Cost of Medical Care brought together a mass of valuable records in respect to the prevalence and cost of sickness and medical care.

Activities which stimulate the collection and study of records constitute a tremendous contribution to the advancement of public health. They point the way toward better adjustment in a rapidly changing world.

Mental health is by all odds the most important problem of the future. Advancement in application of mental hygiene has not progressed very far but there has been a tremendous growth in knowledge concerning this subject on the one hand and a recognition of the problem on the other.

The sheer magnitude of the problem compels serious thought and stirs up apprehensions. Nearly one-half million hospital beds in the United States are filled with nervous and mental patients. The ratio of feebleminded and epileptic patients per 10,000 people in the United States has increased from 2 to 5 since 1904. In Illinois the patients in State hospitals for the mentally defective (insane, feebleminded and epileptic) have increased from 27 to 40 per 10,000 population since 1914. While the entire population increased 30 per cent the institution population increased 48 per cent. The actual number of mental defectives under the care of the State has increased from 16,402 in 1914 to 31,367 on the first of April of this year.

Turner points out that more children are headed for the insane asylum at the present rate of commitment than for college. Birth reports filed by the Illinois State Department of Public Health show that reproduction among the best stock has declined far more rapidly than among the less desirable. The number of children born to mothers of mental defective and retardates is almost twice the number born to mothers of children who are sufficiently intelligent to attend high school and college.

Statistical studies indicate that about 11 per cent of the feebleminded in any generation come from the mating of feebleminded parents while 89 per cent come from the mating of carriers. The latter are people, who though normal themselves, carry over to their offspring the mental defect. This is an illustration with the Mendelian recessive type.

Another phase of the mental health problem is that of maladjustment. Mental illness is frequently functional rather than pathological. Bad training and lack of adjustment to modern conditions can destroy usefulness as completely as biological incapacity. Fully 40 per cent of the crime in this country is committed, according to newspaper reports, by boys under 25 years old. Perhaps three-fourths of these youngsters have sound minds biologically. They are badly trained.

These are disquieting symptoms. They constitute a distinct advancement in public health if they stimulate action in the right direction. The extension of sound eugenics, programs and the employment of psychiatry in our schools are the ways in which to attack the problem. The great store of technical knowledge that makes possible the maintenance of community and individual health at a high favorable level depends upon an intelligence high enough to apply the knowledge.

Technical Advancement

Recent advances in the field of nutrition and food values are voluminous and remarkable. These relate principally to the vitamins. Probably the most far reaching development is the perfection of a method for impregnating milk with vitamin D. This can be done economically and practically in three ways. The fluid milk may be irradiated with ultra-violet rays from a carbon arc lamp, the cows may be irradiated in this way, or yeast may be added to the ration of the dairy herd.

These processes yield a milk that has a high anti-rachitic value. It will prevent rickets in babies and children who have no cod liver oil or other vitamin D concentrate. Even when less than a quart per day is given the children show no more evidence of rickets than do those under the care of competent pediatricians who prescribe cod liver oil or other anti-rachitic preparations.

The cost of irradiating milk by the carbon arc lamp is above 15 cents per 100 gallons under quantity production methods. Thus an economical method capable of almost universal application has been opened up for the control of rickets. Advantage of the opportunity has been seized upon by forward looking dairymen, especially in New England where anti-rachitic milk is a regular market product.

Perhaps the newest trend of thought in the field of nutrition is that a balanced ration of vitamins is required to yield satisfactory results. Thus a concentrate of vitamin A, for example, would not produce the desired results unless the patient has a proportionate volume of vitamin B, vitamin C, etc.

Another refinement of knowledge in this field is a recognition of the fact that humans are born iron-rich and calcium poor. This is a natural condition which has, as Sherman points out, important survival value but it creates a health problem that must be solved by the intelligent use of artificial methods. Poverty of calcium makes the bones of an infant at birth much softer and more pliable than those of an adult. This reduces the hazards of birth to both infant and mother. It also reduces the chances of acquiring sound, durable teeth and sturdy bones. This deficiency must be met by a dietary regimen rich in calcium and phosphorus.

Early this year the Agnews announced that they had succeeded in controlling caries by adding vitamin D and phosphorus to the diet. During recent years Mrs. Mellanly reported that pyorrhea could be produced or prevented at will in puppies by withholding or giving vitamin D in appropriate quantities.

These fragmentary references suggest how rapid have been the advances in the knowledge of nutrition and food values during the last decade or two and indicate the importance which diet is assuming in respect to public health.

Refinement of technique and the adjustment of old ideas to meet new situations has marked the practical advancement in immunology and epidemiology. Knowledge has reached the point where practically all of the gross disadvantages of quarantine can be eliminated under ideal circumstances. With an adequate health service, for instance, it would not be necessary to quarantine at home or prohibit from school the children who have been exposed to measles until the ninth day after exposure. In the face of a scarlet fever outbreak it is a more scientific course to keep open the schools under medical supervision than to close them. The isolation of patients suffering from communicable diseases is now considered a measure that results more in benefit to the patient than in protection of the public.

Under prevailing conditions the carrier is now recognized as a more important source of infection to others than bedfast patients.

Of outstanding importance because of the magnitude of the problem is the refinement of epidemiological methods concerning tuberculosis. The skin test which shows whether or not a person has been infected, together with x-ray pictures of the chest, make possible the almost complete control of this disease. The procedure is based upon the principle that no person can have tuberculosis without being infected with the tubercle bacilli. An individual might slowly starve to death or gradually waste away on stale air and a shortage of sunshine but he would never suffer from tuberculosis unless the germs of that disease get into his body. The source of those germs, moreover, is nearly always a human being. The skin test shows whether or not the tubercle bacilli have gained access to the body.

Children under school age have a narrow range of human contacts. Opportunity of infection is limited to family members, servants, close friends and perhaps nursery school and kindergarten teachers. Thus a positive tuberculin test on a young child indicates a nearby source of infection. Meyers points out that 60 nursery school children were tested under his observation. The test was positive on four children. A search for the source led to the discovery that one of the teachers was tuberculous. Her removal saved the other children from infection. In Massachusetts the source of infection of school children is found to be a member of the family in more than one-half of all cases. Frequently these sources of infection are people who do not know that they are tuberculous. They are all the more dangerous for that reason.

A positive tuberculin test indicates infection only. It does not necessarily mean active disease. Indeed, only about 1 in each 100 children with positive tests is found to be suffering from the disease. Diagnosis in these early and minimal cases can be established only by the x-ray.

This refinement in procedure with respect to tuberculosis must be rated as one of the larger advancements in public health service. It has great potentialities. Tuberculosis still heads the list of fatal communicable diseases with the possible exception of pneumonia.

Methods of scarlet fever control have reached a point of advancement which makes practicable the complete elimination of this disease from institution populations. At least two Illinois schools, that at Mooseheart with an enrollment of some 1,500 and the soldiers' orphans school at Normal with about 700 have succeeded in eradicating scarlet fever. All children are given the Dick susceptibility test. Those who show a positive reaction are given a series of immunizing doses of scarlet fever toxin. A similar course was followed before it closed, a victim of the depression, by the Durant Hospital for Contagious Diseases in respect to candidates for training as nurses. Experience in all three places showed that the test is thoroughly reliable as an index to susceptibility or immunity. In no case did any pupil or nurse who had been vaccinated and thereafter showed a negative Dick test experience an attack of scarlet fever. All three institutions remained practically free from the disease over a period of years although scarlet fever was frequently epidemic in the communities round about.

While it seems impracticable to attempt general vaccination against scarlet fever in the way employed with respect to diphtheria and smallpox, the use of the Dick test might be employed to great advantage especially among school children in the lower grades. The Dick test applied to school children in the fall would show which ones are susceptible. Not more than one-third would fall into this group and they would be mostly in the lower grades. If scarlet fever appeared in the community during the year all

efforts at control could be concentrated on the susceptibles. Even in the face of an epidemic the use of the Dick test and the observation of susceptible children is a far more scientific, practicable and economical procedure than closing the schools.

A particularly promising advancement is the development of serum treatment for patients with lobar pneumonia. An experimental demonstration of this procedure has been underway in Massachusetts since 1931. Progress reports indicate that serum treatment, when given to patients suffering from types I and II prior to the fourth day of the disease, reduces mortality to about one-third of that in non-serum treated patients. This trial in Massachusetts is being observed with the greatest interest. Lobar pneumonia of types I and II is the form which the disease most frequently takes among young and middle aged adults. The perfection of the serum treatment method would be of the greatest significance to public health. Pneumonia usually ranks second or third among the leading causes of death in Illinois. Importance of control is therefore manifest.

Very recently Sauer has reported significant success in preventing whooping cough by vaccination. He used a vaccine prepared under his own direction. A fairly large number of vaccinated children who were undoubtedly exposed to repeated infection escaped sickness entirely. While the procedure may be regarded as still experimental it undoubtedly has value and can be utilized by experts to advantage.

Health problems associated with industry have come to the fore very rapidly in recent years. To cope with these medical knowledge has progressed as rapidly as the need has manifested itself and more rapidly than it has been applied. The McCord test for lead poisoning, for example, seems to be a reliable means for controlling that growing hazard. Some people are much more susceptible to lead poisoning than others. More and more manufacturing processes involve an exposure of employes to this risk.

The McCord test indicates by changes in the blood whether or not an individual exposed to the danger is reacting unfavorably to the risk. Blood changes pointing toward disabling illness can be observed long before definite clinical symptoms of poisoning manifest themselves. The McCord test is, therefore, of significant value in controlling lead poisoning among employes.

The medical examination of candidates for employment in various occupations has become routine practice in a number of industries. These include railroads, bus companies, steel corporations, aeronautics and many of the public services such as policemen, firemen, military, etc. This precaution is a service to both the employes, the public and the industry concerned. Individuals of unstable nervous systems and those with disqualifying physical defects are in this way prevented from undertaking functions that might endanger both themselves and others.

A substantial number of industries have created medical departments through which the growing volume of knowledge concerning industrial hazards are applied. On the other hand, there is room for great expansion in this direction. The chief problem concerns small industrial units. In some localities, as in Philadelphia, this situation has been met through the organization of a medical group the cost of which is pro rated among the industries served on the basis of employe population.

In the field of sanitary engineering the methods of sewage disposal have progressed to the point where it is possible to obtain from the outlet of sewage treatment plants clear, sparkling water that is perfectly purified and safe for drinking. Our esthetic sense would doubtless rebel at drinking water obtained from that source but the sanitary quality of the water is unquestioned.

This sketchy outline of the more noticeable developments and trends in the public health field suggest how rapidly knowledge of a practicable character has come to light. Advancement has taken place along the whole broad front. The gains in end results have been solid and durable. This is proved by the fact that health conditions have been maintained at unusually favorable levels throughout the current economic depression. Under the pressure of prevailing financial conditions no scandals of consequence have come to light in health departments.

These are significant observations. The public health movement is built upon solid ground. Its achievements are a monumental tribute to scientific thought. The methods employed in extending its benefits are a beacon to guide activities in other departments of life.

MEDICAL SCIENCE, ITS PAST, PRESENT AND FUTURE*

BY

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In agreeing to speak upon this subject I accepted a large order, but I assure you that I have never entertained serious notions of filling it. In these days when defaults are so common on everything from such trivialities as teachers' salaries to such important things as bankers' dividends, I felt sure that I would not be held strictly to my bargain. What I really propose to do is to touch some of the high points of medical history, recent and remote, germane to my theme, which might perhaps better be stated as "The Road to Medical Progress".

The art of medicine had its beginnings in the earliest dawning of human development, since the practice of medicine is the inevitable consequence of the existence of disease. It is natural that the attempt to practice the art should be as old as man, since disease in general is not a special product of civilization but is an integral part of the picture of life from its earliest beginnings. The earliest man had the problem of illness to beset him, according to evidence from fossil and other relics. Studies of the pathology of the remains of our remote ancestors are largely confined to those aspects of disease which are apparent from changes in the bony framework of the body and the teeth. The fossil remnants of some of our earliest men give clear evidence of the prevalence of disease of various types. For example, the Rhodesian man found at Broken Hill, which seems to be dated as early Pleistocene or late Pliocene, according to Dr. Hooton, shows, among the fifteen teeth which were found, ten with rather characteristic dental caries. The surrounding bone changes gave indication that there were alveolar abscesses. In the femur which was found with this skull there were abnormalities characteristic of rheumatism. And in the skull itself there is also a peculiar perforation about one-fourth inch in diameter in front of the orifice of the left ear indicating a discharging abscess. In this man one sees the same sort of picture of disease that is prevalent today. His tooth decay could scarcely have been due to abuse of cooked and prepared soft foods, for he lived somewhat prior to the era of oatmeal and corn meal mush. He lived on nuts, raw meat, crude cereals and fresh greens, if evidence from other sources does not lead us astray. But he suffered from the same sort of illness that our more pampered civilization finds itself heir to.

When primitive man began to think about the ways of combating disease in himself, his methods were those of the empiricist. He tried one and another of the means that occurred to him in attempting to rid himself of pain and weakness, and to forestall the death which he had seen his fellows suffer under similar circumstances. Whether his first approach to therapy was through an appeal to mysticism and to the supernatural by the medium of the witch doctor, or whether his earliest attempts were by the

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use of herbs and strange concoctions of rare and oftentimes repulsive substances, one can only speculate. This much is certain, that he struggled with this meagre grasp of the facts to find a remedy for his ills whether it was through incantation or medication. What the earliest man lacked was not a desire to be healed or the willingness to use his best reasoning in finding a way to be healed. Rather it was a dearth, or one might say total absence, of knowledge concerning the causes of disease that frustrated him in his attempts at cure.

Furthermore, the methods employed in attempting to solve the problems of disease and its treatment were not promising. The attempt to cure disease without a knowledge of its cause could scarcely be called scientific. Healers became known as fakirs because of the obvious chicanery and fraud which they practiced. The spirit healers and the witch doctors inevitably failed except when the real nature of the complaint of their patient was nervous and could be affected by the emotional state of the individual. So too, after the herb doctor by trial and error found amongst the plants certain ones which had powerful effects upon the animals or men who happened to eat them, he discovered to his sorrow that for the most part his potions were fruitless. The art of healing in the absence of knowledge of the cause of disease was as apt to be productive of results as the search for the needle in the hay stack. In the almost infinite complexity of types of disease and the equally great variety of procedures for their control or cure the likelihood that by random chance successful measures would be happened upon is extremely small.

The science of medicine may be said to have begun when man began to accumulate knowledge concerning the intimate mechanism of disease, and to try to apply that knowledge to the search for ways and means of curing it. There is no date in history that one can set as the beginning of medical science, because it began very gradually. Knowledge applied to medicine did not become important, however, until late in the recorded history of human civilization, and in truth one may say that a really producitve medical science dates only from the Renaissance. The early Egyptian civilization gives definite evidence of an attempt having been made to study human disease by somewhat exact methods. The Greeks made further progress, but not until after the end of the Middle Ages can it be said that any notable applications were made of the knowledge of physiology and pathology to the treatment of disease. This is largely due to the fact that not until the rebirth of learning in recent times has there been widespread use of the experimental method in biological science.

What are the exact methods by which progress has been achieved in the medical sciences in recent times? How has the treatment for thyroid disorders been discovered? How were the methods developed for the control of Addison's disease, diabetes mellitus, diabetes insipidus, pernicious anemia, syphilis, small pox, diphtheria, to mention only a few of the many diseases with which medical science is now able to cope? I should like to be allowed to sketch hastily the methods by which several important discoveries were achieved. A recent discovery about which nearly everyone knows, is that of insulin for the control of the metabolic disorder, diabetes mellitus. Most of you know that Frederick Banting and J. J. R. McLeod were awarded the Nobel prize for the discovery of insulin, but probably few know how it came to be discovered. Banting and McLeod are credited with this achievement, and they were not, to be sure, without great merit for the part they played in it; but they are no more solely responsible for it than it was "the medical corps that won the war". About a half century before Banting, McLeod and their co-workers put the finishing touches on the job,

Minkowski and von Mering found that removing the pancreas from animals produced diabetes. The story is told that these experimenters came upon this knowledge by accident. They had removed the pancreas from animals for another reason and noticed by chance that insects were unusually attracted to the urine of these animals, which they found on examination contained great quantities of sugar. For the next forty years workers tried to extract a substance from the pancreas which would control diabetes. Time after time the attempts failed, largely because the pancreas also produces in great quantity the proteolytic enzyme trypsin which is extremely toxic to living matter. Then one day a young pathologist at the University of Minnesota, whose name I feel rather sure you have not heard in this connection, Dr. Barron, found that by ligating the external secretory duct of the pancreas and allowing the animal to recover, all the enzyme secreting cells degenerated and left only the cells in the islets of Langerhans. Since no diabetes resulted it became apparent that these islet cells elaborated the substances necessary for proper carbohydrate metabolism. When Banting began to think about curing diabetes he knew of the discoveries of Minkowski and von Mering, and of Barron. He merely took the next step and with the help of a young graduate student whose name is now a household word, Charles Best, he made extracts of such islet tissue, which they found to their satisfaction were not too toxic to be used, and did control diabetes. But they were not chemists, and the problem of extracting the material, which they called insulin, from the islet tissue, was too intricate a problem for them to master completely. So they called in the biochemist J. B. Collip to complete the trick for them. And what did Professor McLeod do? Aside from accepting a share in the Nobel prize, history will record that he judiciously discouraged his ardent young assistants from expecting results too easily. The real story of insulin is a drama of scientific progress, of human foibles, and a beautiful illustration of the place of step by step progress of knowledge in the arrival at practical fruition of scientific results. Insulin required Minkowski and Mering, it needed Barron, McLeod, Banting, Best and Collip, to contribute their small part each to the sum total of scientific fact that now forms the basis for the treatment of diabetes.

Another important recent advance in applied medical science has been the development of our knowledge of the accessory food substances, or vitamins. The knowledge of vitamins had a romantic beginning, because the first definite evidence that substances important to nutrition were absent in certain diets, thought to be adequate with respect to the known nutritional requirements, came from observations of sailors making long voyages without supplies of fresh food. Some very interesting clinical observations were made on the relation of dietary inadequacies to the occurrence of beriberi in seamen. Beriberi is a disease of the peripheral nerves. Its victims become easily fatigued and depressed, their skin becomes sensitive, there is swelling and edema, and the mortality in the disease is very high. It was the scourge of seafaring men in the early days of ocean sailing and not until a scientific analysis of its cause had been made was its occurrence brought under control. Empirical methods of treatment instituted in the years around 1880 pointed the way for a thoroughgoing investigation of the problem, and today there is no longer any reason why sailors or others living upon highly refined and restricted diets need suffer from beriberi. The classical proof of the role of an accessory food substance or vitamin in this disease was made in 1897 by Eijkman, who was medical officer to a prison in Dutch Java. Beriberi was common in that prison and Eijkman noticed that the poultry which were fed on the garbage of the hospital died with a disease picture very similar to that of his own patients. He was therefore

led to investigate this problem thoroughly and fed pigeons some rice in the natural condition, with the husk on the grain, and others on rice from which the husk had been removed, but still retained the outer layer or silverskin, and the embryo or germ. Still others were fed on polished rice from which these latter parts had been removed. He found that all the pigeons fed on polished rice died of polyneuritis or beriberi, while those fed the whole grain or the grain still retaining the outer layer and the germ did not develop the disease. He therefore proved that the absence of the material removed in milling and polishing rice was responsible for the disease. He thought erroneously that it was the silverskin itself which contained the substance which protects against beriberi, whereas, as a matter of fact, we now know that this substance is in reality concentrated in the germ of the seed which he removed with it. His practical deduction, however, was correct, that rice polishings, when fed, protected against beriberi. At the time of his studies two-thirds of the people in the large cities of the East Indies suffered from beriberi. Among prisoners as many as eighty per cent showed symptoms of the disease in institutions where polished rice formed the main article of the diet. The disease has all but disappeared since unmilled rice has been substituted in institutions, and the incidence in the population at large is diminishing rapidly with the dissemination of popular information concerning the cause and cure of the disease.

The antiberiberi substance is now known as vitamin B. More recent work by McCollum and Hopkins showed that the lack of vitamin B causes a retardation of growth and it has been indicated by chemical studies that there are really at least two substances included in what was thought to be vitamin B, the absence of one of which leads to the human disease beriberi, another leads to inadequate growth, while a third may be related to the disease pellagra.

The development of knowledge concerning the vitamins presents a story of the application of the experimental method in biology and medicine which is scarcely excelled in any other instance. Knowledge has been acquired by painstaking observations of apparently inconsequential details. In these times when the scientific method as a whole has been attacked by persons in high places in academic life, it may not be amiss to point out that we would not have any of our important knowledge of the vitamins if scientists had disdained to spend months, and even years, of their lives studying carefully the minute details of the nutritional requirements of common laboratory animals.

The scientist has been accused of being anti-intellectual in that he places his reliance on observations rather than logic. If it is true that placing reliance on observed facts, instead of abstract logic, is anti-intellectual, then I, for one, wish to challenge the significance of the word intellectual. If intellectualism requires blindness to reality in subservience to logic, then certainly intellectualism is a sterile formula. I suspect that those persons who have criticized the experimental method as the sine qua non of progress in science have confused intellectualism with pedantic scholasticism. A further surmise may be permissible that the modern pedantics who rail at the "blizzards of facts" which modern science has contributed to knowledge, find themselves in a "state of bewilderment" because they themselves are incompetent to grasp the true meaning of the observations which experimental science has placed in the hands of humanity.

Nor is it a new complaint for scientists to hear that the experimental method is essentially anti-intellectual. The dark ages were full of such talk, and the rebirth of learning, with its general acceptance of the experimental method, did not in itself endow the entire human race with enough intelligence to be able to appreciate its significance.

The question may be asked as to why the use of the experimental method in biology has been so tardy in coming to fruition. In the biological sciences there are numerous serious difficulties standing in the way of experimentation. In the first place, analytical study requires the use of living animals and frequently requires that changes in their environment and their make-up must be produced in order to permit controlled observations of individual phenomena. In order to experiment on animals effectively, means had to be developed for producing anesthesia. Before the discovery of anesthetics, experimentation on animals was confined largely to those observations which could be performed without inflicting pain. It can truthfully be said that the advent of anesthesia was the greatest single advance ever made in the development of tools for biological research. It should be noted, in passing, that the development of anesthesia, which was itself a result of animal experimentation in pharmacology, was also one of the greatest boons to mankind directly that science has ever accomplished. For us to consider the practice of medicine and surgery today without the use of narcotics and anesthetics is to consider a practice so archaic as to be absurd. The possibility of safe anesthesia is undoubtedly as important to mankind as any other result of modern science.

After speaking at length of the importance of animal experimentation, it seems necessary to consider briefly the problem of the ethics of the use of animals in this way. Living in such a homocentric civilization as we do, it may seem to some that there could be no room for argument concerning the propriety of taking the lives of the lower animals for the furtherance of human welfare. Of course, in the history of mankind there seems never to have been any very strong sentiment against the use of animals for man's purposes. Long before animals were domesticated our savage ancestors employed animals of all sorts for their food, just as we, as a matter of fact, do to large extent today. In other words, man has collectively always felt justified in using the lower animals for his food, as his beasts of burden, and even, one may add, for his enjoyment in hunting, fishing, racing and fighting. It is a strange paradox that in our civiliation, which has never questioned the right of man to slaughter animals for his food and enslave them for his convenience, there should actually grow up a strong sentiment amongst a small minority against the use of animals for the furtherance of knowledge and of health. Surely there can be no logical grounds for denying the right of men to employ animals for the highest good known to man—that is the furtherance of knowledge, particularly in relation to problems of health—when the propriety of almost wanton destruction of animal life in hunting and fishing, to say nothing of the orderly business of slaughtering animals for human food, is accepted as correct. There are, as a matter of fact, many experimental biologists who are perfectly willing that animal life should be sacrificed for the real good of mankind in connection with the provision of food and with the increase in knowledge who are strenuously opposed to the destruction of animals by relatively cruel methods in hunting and fishing. It seems, to the mind of one who believes that scientific research in biology and medicine has been of great value to human welfare, that so long as the thesis that animals may be used for human welfare at all is maintained, there can be no question about the propriety of animal experimentation.

The opponents of animal experimentation attempt to prejudice the issue by referring to it as vivisection. There is a certain emotional reaction aroused by the idea of cutting up live animals that is unwarranted by the actual facts of the case. The serious scientist does not conduct experiments which are apt to produce pain without the use of anesthetics, except when

it would be absolutely impossible to obtain valuable information in any other way. In almost all experimental work, whatever cutting of tissues is to be done is carried out under adequate anesthesia. Even if it could be shown that in rare instances a scientist has been known to carry out experiments in an unnecessarily painful manner, either by error or by intention, there is no ground for criticizing all experimental biologists by the same token. It is, undoubtedly, true that occasional instances have occurred where a scientist has not observed all due precaution to avoid pain and suffering. These instances are exceedingly rare, however, in proportion to the number of experiments performed by biologists as a whole; and what one should do is perhaps to criticize the individual scientist for his indiscretion; but to condemn the whole practice of animal experimentation on the basis of occasional abuse is as intelligent as it would be to criticize the whole practice of civil government because an occasional officer of law enforcement is unreasonable in his application of law to specific instances. No sane person denies the necessity and value of an ordered society simply because certain agents of an organized society abuse their privileges and power. Neither should one criticize the practice of animal experimentation in the welfare of humanity simply because an occasional individual has been known to carry on unnecessarily painful experiments. It should be emphasized at this point that instances of such indiscretions on the part of biologists are as a matter of fact exceedingly rare, but it cannot be too strongly insisted that there is no one who regrets their occurrence at all any more fully than do the rank and file of biologists themselves.

The activities of the organized groups opposed to animal experimentation are a menace to the progress of science because they would make it impossible for biologists to do any effective experimental work. One is led to inquire as to the motives that prompt the so-called antivivisectionists in their fight against biological work. The antivivisectionists include three major groups. The first are the antimedical bloc; the second are the professional agitators interested in the movement because it affords them a living; and the third are a group of very well intentioned, but misguided, people who support the movement because it claims to be humanitarian, and they are opposed to anything that could be considered to be inhuman or cruel, as the first two groups have portrayed animal experimentation as being.

The antimedical group are the Christian Scientists, the chiropractors, the osteopaths, naturopaths, and those following the other "paths" that are not quite straight and narrow. They are attempting to embarrass medical science by every means, legal and extra-legal, at their command and are using this as one method of achieving their ends. The sane portion of the population will surely never allow this unbalanced group of people to deprive humanity as a whole of the benefits which are accruing and will undoubtedly still accrue in the future from observations on animals.

The second group of professional agitators comprise the paid officials of the various propaganda organizations against biological research. These persons are supported, some of them rather lavishly, by the first group mentioned, and, unfortunately, also by some of the well meaning people in the third group, to be discussed in a moment. Many of these agitators have admitted that they have no interest other than a commercial one in antivivisection propaganda. These paid propagandizers are the most vicious element in the group. They are the lobbyists who attend every session of the state legislature and even of the National Congress, having bills introduced, pulling wires, and altogether exerting as much influence as they can in a political way, to embarrass legitimate biological research.

The third group amongst the rank and file of antivivisectionists is the large number of well meaning, but misinformed, individuals who are led by those who have an axe to grind. It is of this group that we should be particularly solicitous. They are largely people who have simply never been informed about the real situation. They have listened to an inaccurate or exaggerated account of scientific experiments on animals out of the mouths of the promoters, the quacks, and the mentally unbalanced. What these people need is information concerning the realities of the situation. They should be taken to see experimental laboratories. They should be told of the benefits of animal experimentation to mankind. They should be reassured that animal experimentors in science are probably as solicitous of the welfare of animals as any other group of people in the community. The checking of the growth of the power of the antivivisectionist movement depends upon winning these misled people away from their biased, bigoted, and unscrupulous leaders.

Finally, a word should be said about the possibilities for the future of medical science. It would be futile to attempt to predict exactly what lines of investigation will prove fruitful within any specified period of time. There is only one point that it is really worth while to make concerning the future of medical science, namely, that progress is possible only by the further application of the experimental method to its problems. We shall not achieve new successes in the field of medicine comparable to the discovery of insulin, to the conquest of rabies, to an understanding of the methods of control of smallpox and typhoid fever by arm chair research. We have a vast amount of information in the biological sciences which is, at present, uncorrelated, to be sure, but its correlation does not wait for a master mind to put two and two together. Rather, it waits for the filling in of missing links in the structure of our knowledge. It is incomprehensible to scientists who are working in the field that the discoveries which have already been made and applied for human welfare could have been accomplished in quiet contemplation without the use of the experimental method. To be sure, a well reasoned experimental approach is the secret of practical success in scientific work. No scientist would be so blind as to deny the value of logic in the planning of experiments, but anyone who insists upon the superior importance of *a priori* reasoning over observation is simply entirely blind to the whole history of scientific progress. We can look for a ripening of the fruits of scientific labors only by continuing assiduous cultivation of the experimental method.

In summary, I should like to review the ground that I have tried to cover. I have attempted to show, by what has necessarily been a very meager group of examples, the methods by which achievements have been made in biology and medicine. I must apologize for having drawn all of my examples from the realm of physiology. I have chosen to do so only because of my greater familiarity with that field. Equally important examples could be drawn from the field of bacteriology, from pharmacology, or from anatomy. It has seemed obvious that in all of the instances cited the addition bit by bit of observational knowledge has been the basis of scientific progress. I have tried to show that all of this progress has depended upon the use of animals in experimental work, that the sacrifice of animal life to this end is justifiable for the welfare of humanity. Since, in general, the human race has insisted that its interests are paramount to the interests of any other species of animal life, there seems to be no question but that a sacrifice of animals for the increase of scientific knowledge is entirely justifiable on ethical grounds. Until the population at large becomes vegetarian and forgoes the use of animals for all domestic and

commercial uses, the scientist should not be required to justify his use of animals for the welfare of humanity. I have tried to call attention to the menace of the organized vivisectionist movement, and I have pointed out the ulterior motives animating a large share of the people back of this movement. Finally, I have stressed the importance of continued animal experimentation in furthering medical discovery. I hope that I have made clear how intimately the progress of biological knowledge is connected with the employment of the experimental method which is in jeopardy by virtue of the activities of the antivivisectionists. The future of animal experimentation is the future of biological science, and it behooves those who are interested in the latter to foster, encourage and protect the former.

PSYCHIATRY IN THE CRIMINAL COURTS OF COOK COUNTY*

BY

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Report for the Fiscal Year, 1933

Organization.—The Behavior Clinic of the Criminal Court of Cook County, which came into existence April 1, 1931, is essentially a diagnostic clinic, giving advisory psychiatric service to the Judges of the Criminal Court. The Clinic is disinterested in the legal aspect of the cases referred for examination. Its aim is the intensive study of the individual offender—his mental, physical and emotional make-up—his environment, and the interaction of that individual and that environment. It is hoped that such a scientific study will make for a better understanding of criminals and the forces motivating anti-social behavior and thus help to combat the menace of crime to society.

Scope and Method.—A psychiatric examination may be availed for any offender whom the presiding judge sees fit to have examined. Requests for examinations are made for numerous reasons, the most frequent of which are: 1) to determine the sanity of the individual; 2) to determine his intellectual capacity; 3) to determine his suitability for probation.

Every patient referred to the Behavior Clinic is given several types of examination: 1) a psychological examination by the psychologist to ascertain his mental ability and to determine what can be expected of him in terms of social and industrial adjustment; 2) a comprehensive social history of the patient from relatives, friends, other agencies and individuals who have had contact with him, to learn all the pertinent facts concerning his family background, early life history, later experiences, and a detailed study of his environment in an effort to arrive at a more thorough understanding of the patient in view of his background; 3) a physical examination with special attention to constitutional and neurological defects when such an examination appears necessary; 4) a psychiatric examination by the psychiatrist: (a) to evaluate the personality manifestations of the person; (b) to coordinate all findings and from them make a report to the judge for use in determining the disposition of the case.

Before the hearing copies of the psychiatric examination and conclusions are sent simultaneously to the presiding judge, State's Attorney, and attorney for the defense. After legal disposition of the case copies of the psychiatric, psychological and social service reports are sent to the institution to which the patient is committed or sentenced, or to the Adult Probation Department should he be granted probation.

Referrals.—Since the Clinic's inception 790 cases have been referred for examination, of which 316 were referred during the fiscal year of 1933, an increase of 3 per cent over the number of referrals in 1932. Of these, 302 cases received the routine psychiatric and psychological examinations and

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* Presented before the Twenty-sixth Annual Meeting of the Illinois State Academy of Science, East St. Louis, Illinois, May 5, 1933.

intensive social service investigations; 2 were given physical examinations only upon order of the presiding judge; 10 either refused examination or were discharged before the psychiatrist could see them; 2 have not yet been examined.

Diagnoses.—Sixteen per cent of those examined were found to be actively psychotic and were committed to hospitals for mental diseases. Ten per cent were found to be mentally defective to an extent warranting commitment to an institution for the feebleminded. An additional 6 per cent were mentally defective (borderline), but not sufficiently low for commitment. It happens that heretofore in the majority of these cases our findings of feeblemindedness have had necessarily to be disregarded by the Court because of the danger of escape from a hospital for the feebleminded (such as Dixon or Lincoln), and the offender, if found guilty, sentenced to Pontiac or Joliet. However, since the establishment of an institution for the defective delinquents and the passage of new laws by the State Legislature permitting the commitment of such individuals to the Department of Public Welfare, the defective delinquents, so diagnosed by the Behavior Clinic, are being committed to the Department of Public Welfare at the Joliet Penitentiary and from there are transferred to the proper institution. Our findings obviously expedite matters for the Diagnostic Institute at Joliet, for the psychiatrists there accept our findings without further examination and dispose of the prisoners accordingly.

About 8 per cent of those patients examined were found to be suffering from some mental or nervous disturbance or personality defect (psychopathic personality, drug addiction, neurosis, emotional instability, inebriety, epilepsy, ambulatory automatism), but not sufficiently serious to warrant commitment by the Court to a hospital for mental diseases. In most of the cases treatment has been recommended. The remainder were found to be negative, that is, no evidences of organic or functional nervous or mental disease were ascertained.

Sources of Referral.—The cooperation of the Judges and every division of the Criminal Court has not only continued but increased. Despite the change in the judges sitting in the Criminal Court, orders for examination originating directly from the judges has increased. In 1932 approximately 35 per cent of the cases referred to the Behavior Clinic for examination were requested by the judges themselves. In 1933 approximately 50 per cent were requested by the judges. Most of the judges sitting in the Felony Court have referred cases to the Behavior Clinic for examination, and several of the judges from the Boys' Court. A judge of the South Chicago Court referred a boy for examination who was being held in the County Jail awaiting trial in his court. The Public Defender's office has requested examinations in approximately 16 per cent, and the State's Attorney's office about 5 per cent. The public at large seems to have become more aware of the Clinic's service for 10 per cent of the private counsels for defense have referred cases to us as against 5 per cent of last year. Referrals by members of the patient's family, or friends, has shown a slight increase from 3 per cent of last year to 4 per cent of this year. The jail authorities (the Warden, Assistant Warden, and Jail physician) have referred 6 per cent; other social agencies, including the Bureau of Public Welfare, Criminal Court division, Rural Service and Veterans Service divisions, and the Juvenile Court, about 7 per cent; the Adult Probation Department 2 per cent. In one instance a Federal Probation Officer referred a female drug addict for examination; the Parole Officer of Pontiac Reformatory asked for examinations of two boys on parole whom he had incarcerated in the County Jail for the purpose of examination. (In both instances the boys were found to be psychotic.)

Charges.—Individuals charged with every type of offense from disorderly conduct and vagrancy to incest and murder, have been referred to us for examination. Of the cases referred the largest number were those indicted on sex crimes (32 per cent), including rape (10 per cent of the total number referred), crime vs. children (14 per cent of the total number referred), crime vs. nature, incest, indecent liberties, and contributing to the delinquency of minors. The next largest group were those charged with robbery, (17 per cent), 15 per cent of the cases referred were charged with murder, 13 per cent with burglary, 9 per cent with larceny and 4 per cent with "white collar crimes", such as embezzlement, forgery and confidence game. Among the offenders referred for examination were individuals serving sentence at the County Jail for violation of the Municipal Code on such charges as disorderly conduct, soliciting, vagrancy and non-support. In five instances individuals held in the County Jail for safekeeping while awaiting transportation to Federal prison or other institutions were referred for examination.

Stage of Referral.—Though it was intended that examinations by the Behavior Clinic be made after an individual was convicted of a crime, but not yet sentenced, the majority of the cases (80 per cent) have been referred after indictment, but before conviction; 12 per cent were referred after arrest and before indictment; 3 per cent referred were already serving sentence in the County Jail. The remainder were in the County Jail either on habeas corpus writs, for safekeeping for parole officers, or were prosecuting witnesses.

Additional Services.—The Behavior Clinic performs many services to the Court incidental to its work proper. Sometimes emergency physical examinations have to be made and patients treated. On a few occasions the psychiatrist has had to make home or hospital visits to determine the fitness of an individual to appear in court. Occasionally the psychiatrist is called into court to answer questions involving psychological phenomena.

(1) *Expert Testimony.*—The psychiatrist is called into court to testify regarding a patient's mental condition in cases where a diagnosis of a psychosis (insanity) or feeblemindedness has been made warranting commitment to a State hospital. Thus the Court is saved the expense of paying outside psychiatrists for their testimony, and even more important, eliminates the so-called "battle of alienists", for the findings of the Clinic are, in nearly every case, accepted by the State and the Defense as impartial unbiased conclusions.

In many instances where a patient is found to be suffering from a mental disease he is committed at once to a State hospital upon testimony of the Clinic psychiatrist. Thus, not only are matters expedited, but the County is saved the expense of a trial, the impaneling of a criminal jury, the time of the judge, the prosecution and the defense. And the patient is spared the ordeal of a trial until his sanity is recovered.

The psychiatrist has on several occasions been called by the State's Attorney's office to examine a suspect in a murder case at the time of the inquest, especially where it is anticipated that insanity will be used as a defense. (In the recent Wynekoop case Dr. Hoffman, besides making psychiatric examinations of the chief suspects, Dr. Alice Wynekoop and her son, was present during every interview with all the suspects in the case. During the initial investigation in the State's Attorney's office the psychiatrist was called in to make a psychiatric examination of the Touhy gangsters suspected in a pending kidnapping case).

(2) *Education.*—Frequent informal conferences are held between the psychiatrist and judge or attorney concerning medico-legal problems. It is very encouraging to note the growing interest among the practitioners of

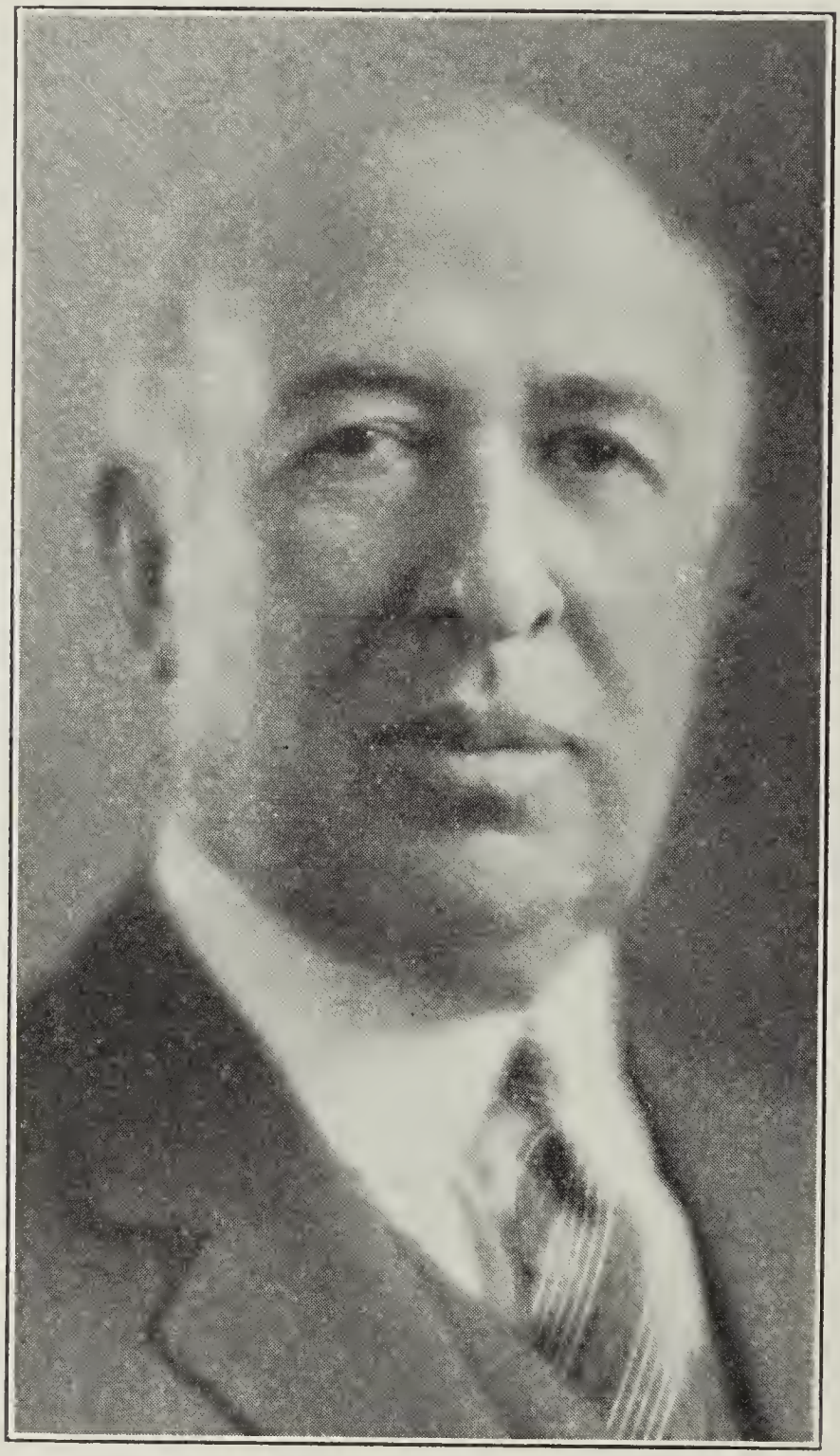
law in the causes of criminal behavior and its treatment, to note the veering away from the old conception of a set punishment for a set offense—a step, we feel, in the right direction.

(3) *Reform.*—Just as after years of discussion in medical, legal and academic circles the Behavior Clinic finally emerged, so too, after much discussion and finally through the concentrated efforts of the Behavior Clinic, an institution for defective delinquents and a radical change in the commitment of that type of offender, have been evolved. Though the need has been long standing, it was not until Dr. Harry R. Hoffman cohesed the general agitation into concrete meetings, committees and potent propaganda, that an amendment to "An Act to better provide for the care and detention of feebleminded persons", was finally passed by the State Legislature. In September, 1933, a theory became an actual reform. By this law defective delinquents are committed directly to the State Department of Public Welfare who in turn, after receiving an intensive psychiatric study at the Diagnostic Depot in Joliet, are classified and committed to the proper institution. In those instances where a patient has been examined by the Behavior Clinic the findings of the Clinic are accepted without further examinations; thus the time and expense of the psychiatric group at the State Penitentiary are saved.

Personnel.—It is intended that all the members of the staff will eventually be placed under Civil Service. Thus far only the supervising psychiatric social worker falls in this category. The psychiatrists were selected by the Chicago Institute of Medicine; the psychologist and medical stenographers were appointed by the Director of the Clinic. The staff as it was originally conceived, consisting of two half time psychiatrists, a full time psychologist, a resident physician, two psychiatric social workers and stenographic service, was barely adequate. With the depleted budget, effective since March, 1932, which eliminated entirely the services of the resident physician and one social worker, and cut the psychologist's services to half time, the Clinic has been working under a handicap, despite which the case load has increased and the service widened, especially since the Courts have become acutely aware of its existence and dependent on its services.

The Behavior Clinic has now been in existence for 32 months. We feel that it has well justified its establishment not only for its work as an advisory psychiatric service to the Courts, nor as an economy measure effecting a savings to the County, but more important, for its inculcation into the spirit of the law and the philosophy of those practicing it, the conception of the offender as a mentally sick individual in need of study and treatment rather than a pariah to be punished according to the heinousness of his offense.

MEMOIRS



Ulysses Sherman Grant

ULYSSES SHERMAN GRANT

1867–1932

Ulysses Sherman Grant, one of the founders of the Illinois State Academy of Science, died in Evanston, Illinois, September 21, 1932. He was then Professor and Head of the Department of Geology and Geography of Northwestern University, a position he had accepted in 1899. He was Vice-President of the State Academy of Science during 1914–1915, and its President in 1915–1916. He was the temporary chairman of the group that founded the Academy in 1907, invariably attended its sessions, and participated in its business and programs with constant energy and interest. In like manner he maintained an active membership in the Chicago Geographic Society, was its First Vice-President for a term of years, and was a member of its Board of Directors at the time of his death.

Professor Grant was born in Moline, Illinois, February 14, 1867. During his undergraduate years at the University of Minnesota he developed an interest in the field of zoology, and in this he held a fellowship there after his graduation in 1888. During later post-graduate work at Johns Hopkins University, however, he transferred his major interest to geology. Attaining his doctorate in 1893, he returned to Minnesota to serve as Assistant State Geologist from 1893 to 1899. During that time he taught in the University of Minnesota for one year. After coming to Northwestern University he was actively associated with the Wisconsin Geological Survey, the United States Geological Survey, the Illinois Geological Survey, and the Oregon Bureau of Mines and Geology. From 1897 to 1904 he was one of the editors of the American Geologist.

Professor Grant's contributions to geological science have ranged over a wide field, but first in his interests was the study of the crystalline rocks. Some of his field studies were made along the International Boundary and in the region lying north of the west end of Lake Superior. It is noteworthy that this same area later became the scene of some of his most effective teaching of field geology. During this early period of creative labor between fifteen and twenty reports appeared in the publications of the Minnesota Geological Survey, the culmination of his studies in this field appearing in Volumes IV and V of the final reports of that Survey.

In 1900, and in closely following years, his studies were directed in part to ore bodies, particularly the lead and zinc ores of southwestern Wisconsin. His mapping of the ore bodies and the accompanying reports are embodied in the Bulletins of the Wisconsin Geological Survey, and in the Lancaster-Mineral Point Folio of the United States Geological Survey. For the latter Survey he was detailed to make an investigation of the ores and crystalline rocks of the vicinity of Prince William Sound and the Kenai Peninsula in Alaska. He visited these regions during three summers and three Bulletins of the United States Geological Survey incorporate the results of his studies.

At Northwestern University Professor Grant's large intellectual caliber and broad sympathies brought him into close relationships both with his colleagues and with students. He served the University on many advisory and administrative committees. On two occasions, one of them during the World War, he was drafted to act as Dean of the College of Liberal Arts. His interest in his students did not terminate with the completion of their classroom work but followed them into later life. None recognizes more keenly than they the value of his competence in teaching and the worth of his friendship.

JOHN PAUL GOODE

JOHN PAUL GOODE

1862–1932

John Paul Goode died on August fifth, 1932, at his summer home at Little Point Sable, Michigan. His brief illness came shortly after the publication of the revised edition of his School Atlas, and his last days were enlivened by letters of congratulation. He remained to the end the happy, enthusiastic personality known to hosts of students and friends.

Professor Goode was born on a farm near Stewartville, Minnesota, November 21, 1862. He graduated from the University of Minnesota in 1889 and accepted a position at the newly-opened normal school at Moorehead where he remained for nine years, doing graduate work at Harvard in 1894 and at the University of Chicago in 1896–97. In 1898 he went to the State Teachers College at Charleston, Illinois, and two years later to the University of Pennsylvania where he received his Ph. D. in geography in 1901 and remained two years as instructor.

In 1903 the University of Chicago established a department of geography under the headship of Rollin D. Salisbury who promptly invited Dr. Goode to an assistant professorship. The presence of these two brilliant scholars and teachers soon attracted a following of both undergraduate and graduate students, and the department grew rapidly. Dr. Goode was advanced to an associate professorship in 1910 and to a professorship in 1917.

Dr. Goode's activities extended far beyond the classroom. He was one of the founders of the Geographic Society of Chicago, served as president for two years and as a director for more than two decades. He was co-editor of the Journal of Geography from 1901 to 1904. In 1908 he made a study of the principal European ports for the Chicago Harbor Commission. In 1909 he was appointed one of the government escorts to the Honorable Commissioners of Japan in their transcontinental tour. Two years later he lectured for the Philippine Government at the Baguio Assembly.

In his later years Dr. Goode gave increasing attention to research and writing. He brought out a set of desk maps and a significant series of physical and political wall maps of the world and of each continent. For years he wrestled with the baffling problem of a map projection of the world on an equal-area basis. He advanced the solution in 1916 with his interrupted homolographic projection and solved the problem in 1923 with his interrupted homolosine projection. These projections represent a basic advance in cartography. In the brief interval since their appearance, they or projections based on them have been used in technical publications of several governments and by practically all important map-making institutions of the world. The climax of Dr. Goode's work is represented in his School Atlas, first published in 1923 and recently revised and enlarged. In it he combined the long experience of a mature geographer with the technical ability of a master cartographer. As a result the Atlas has both scientific and educational distinction.

Professor Goode received many and varied recognitions of his work. His outstanding ability on the lecture platform brought him invitations to speak before Chambers of Commerce, geographic societies, state educational associations, and many other organizations. He served a term as general secretary for the American Association for the Advancement of Science. In 1923 the Geographic Society of Chicago awarded him its Helen Culver Gold Medal for "distinguished achievement in cartography." He was a charter member of the Association of American Geographers, serving as vice-president in 1916 and as president in 1926.

Many students and scientists are indebted to Dr. Goode. He truly was a pioneer in geography, a leader in cartography, and a stimulating influence to his fellow men.

CHARLES C. COLBY

TRANSACTIONS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

VOLUME 26 MARCH, 1934 NUMBER 3

Papers Presented in the Twenty-sixth Annual Meeting, East St. Louis, Illinois May 5 and 6, 1933

EDITED BY DOROTHY E. ROSE

Printed by authority of the State of Illinois
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June, 1934

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PAPERS IN AGRICULTURE

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

The program of the Agriculture Section was devoted to a symposium of six papers on the general subject, "Problems of the Soybean Industry."

The paper by Otto Eisenschiml, Scientific Oil Compounding Company, Chicago, entitled "The Use of Soybeans in Industry," was not presented for publication.

Average attendance at the meeting was seventeen, maximum was twenty-five.

The acting chairman was reelected for 1933-34.

(Signed) H. W. MUMFORD, *Chairman*

HISTORY OF SOYBEAN DEVELOPMENT IN THE UNITED STATES

BY

C. H. Oathout

Western Illinois State Teachers College, Macomb, Illinois

ABSTRACT

The soybean has been known in most of the countries of the Orient since prehistoric times. Over fifty different names have been listed by Piper and Morse, United States Department of Agriculture, thus showing its great antiquity. It is said to have been mentioned by the Chinese Emperor Chen Nung in the ancient Materia Medica in the year 2838 B. C. It is also described in several ancient Chinese dictionaries under different names, one of which was *sou* from which, these authors suggest, our recent names *soi, soy, soja* and *soya* are probably derived. DeCandolle says it is doubtless the plant called *shu* in the Chinese writings of the time of Confucious; that the species was wild in Cochin-China to the south of Java when the ancient people of this region began to cultivate it at a very early period.

A good deal of confusion seems to have prevailed for many years concerning the correct botanical name. However, after much study of the subject Piper and Morse concluded that the correct name must be *Soja max.*

The soybean found its way into Europe near the close of the eighteenth century, its culture having been recorded in England in 1790. It was introduced into the state of Pennsylvania in the United States in 1804, but for many years received only occasional notice. Morse, in Farmers' Bulletin 1520, states that since 1890 nearly all of the state experiment stations in the United States have conducted experiments with it.

It has been only during the last twenty to twenty-five years that the farmers of the United States have given attention to the crop, though a report read by W. H. Stoddard of Macoupin County, Illinois, at a farmers' institute in 1898 shows that the farmers of that community had a good deal of practical knowledge concerning it. No figures showing the acreage produced in the United States are given until the year 1917 when 460,000 acres were reported from seventeen states. In 1924 there were 2,500,000 acres grown of which 613,000 acres were harvested for seed. In 1930 the acreage grown for seed was 1,105,000 of which 843,000 acres were grown in seven states. Illinois led with 321,000 acres, followed in order by North Carolina, Missouri, Iowa, Ohio, Tennessee, and Oklahoma.

Probably the most important by-product of the soybean is oil which is used in the manufacture of paint, varnish, linoleum, oilcloth, artificial leather, etc. In the year 1922-23 9,528,000 pounds of soybeans were used in producing 1,482,000 pounds of oil. By 1929-30 this had increased to 95,676,000 pounds of beans producing 12,482,000 pounds of oil.

Experiment stations in the United States have done much in improving varieties. This is notably true in Illinois, where, under the direction of Dr. C. M. Woodworth, the Illini, an early variety of great merit has been developed.

SOYBEAN PRODUCTION IN ILLINOIS

BY

W. L. BURLISON

University of Illinois, Urbana, Illinois

ABSTRACT

Six hundred and seventeen thousand acres of soybeans were produced in Illinois in 1932 with a crop that amounted to over 6 million bushels. Because of the potential importance of the soybean in Illinois, the Illinois Agricultural Experiment Station has conducted through more than a quarter of a century investigations on the production and utilization of this crop. The present paper is intended as only a very brief resumé of certain phases of our studies.

Varieties.—Definite studies on soybeans in Illinois were first made by the Illinois Agricultural Experiment Station in 1897. From that day to this, literally scores of varieties and types have been under observation and trial. Superior varieties have been discovered from time to time which, naturally, have largely supplanted those of earlier domination. For example, varieties of outstanding promise recommended in 1923 were Manchu and Virginia, and in 1932 were Illini, Dunfield, and Mansoy.

It is interesting to note the range in yield of the varieties. They vary upward from 16 bushels per acre to approximately 35 bushels. Yield has always been considered an important factor in choice of variety, but present-day industrial requirements have shifted emphasis to quality as well as yield. A selection by the method of plant breeding made by Doctor C. M. Woodworth of the Department of Agronomy here at this Station, called the Illini, was distributed in 1928 and has averaged 40 bushels per acre for a period of ten years. About half of the beans now grown in Illinois for commercial purposes are of this new variety.

Date of Seeding.—Experiments carried on for the past six years have brought out the fact that date of seeding soybeans is an important matter in production, especially when quality is considered. Varieties have been seeded at ten-day intervals from May 1 through and including June 20, and the results show that there is practically no difference in the yield of the first three seedings; namely, May 1, May 10 and May 20, but from the June 1 planting yields declined until the last seeding June 20.

Rate of Seeding.—Five years' results on the effect of rate of seeding on yield have changed opinion in regard to this matter. Years ago, when seeded in rows, it was thought that 30 pounds an acre were quite sufficient. Now a larger amount (50 to 70 pounds) is commonly used. In seeding beans "solid," as in the case of planting with the 8-inch grain drill, a higher rate of seeding is required than where the beans are seeded in 24-inch rows. The yields, however, from the solid seedings were distinctly lower than the yields for the 24-inch rows. The labor item and available equipment are of considerable importance in determining this practice.

Longevity and Storage.—The matter of storage and longevity, as it affects yields are, of course, closely related. Studies on longevity of seed of five varieties stored under favorable conditions show that there is a steady loss in the yield of beans when stored for a period of from one to five years. Rapid deterioration in the germination for the first year is not necessarily true. After a two-year period, however, there was a distinct loss in germination and yield although varieties differ materially in the length of time they remain viable and in the ability to produce vigorous plants when seeded.

THE USE OF SOYBEANS AS HUMAN FOOD

BY

EVERETT E. ROQUEMORE

Allied Mills, Inc., Chicago, Illinois

ABSTRACT

Although the soybean has been referred to as the meat and milk of the Orient, the average American knows little if anything regarding the value of products of this plant in the human diet. The possibilities in the use of the soybean as a food for humans as well as for livestock should be of great interest to the thousands of farmers who have become interested in producing this crop, but who now are directly confronted with the problem of widening the market outlet for the soybean.

History tells us that soybeans have constituted the principal source of protein in the Chinese diet for more than 100 generations. Scientists in different countries, particularly Italy, Germany, England, and France as well as our own country, have been interested in investigating the soybean for human nutrition and the facts regarding the value of the soybean as a source of food supply are gradually gaining recognition.

The medical profession has recognized the soybean as a valuable food for diabetics on account of its freedom from starch. It also carries an unusual amount of those peculiar nitrogenous compounds, designated collectively as "protein", which play such an essential role in the nutritive processes.

In the Orient where the soybean to a large degree takes the place of milk in the diet, a cheese-like material is prepared by a well known process and extensively used.

The chemical composition of the soybean as compared with that of our ordinary grain products is extremely peculiar. Not only does it analyze as high as 35 to 40 per cent of protein but it also carries 17 or more per cent of oil, besides 5 or 6 per cent of minerals. Moreover, it is found to be very rich in vitamins, so that altogether the soybean represents the most concentrated, natural, common foodstuff available.

A soybean flour is now coming into use. It is prepared by dehulling the beans, extracting the surplus oil, and bolting the pressed cake into a fine flour. This product has a pleasing nut-like flavor. The flour is used in making breads, cakes, pastries, ice cream and other food materials.

A substance of special value extracted from soybeans is lecithin, formerly prepared largely from yolks of eggs. Lecithin is a phosphorus compound useful in building up nerve tissues.

Soy sauce is another oriental preparation that is now being made in this country under sanitary regulations.

Soybean sprouts are prepared by soaking the beans for a period in water in a warm place and permitting them to sprout through a period of four to six days. The sprouts are then kept in a cool place until served as salad, in stews, and in other ways.

The Chinese prepare soybean milk by grinding with water between millstones, filtering through cheesecloth, and boiling. This material will coagulate, forming a curd which resembles cheese.

When used as a binder for meats in the making of sausages and meat loaves, Soya Flour improves the flavor and appearance of products in which it is blended without increasing cost.

Soybean oil, properly refined, makes an excellent table oil.

Thus with all these various products for human consumption it would seem that the extension of the utilization of the soybean can well be encouraged, thus creating a wider market outlet for this valuable farm crop.

THE FEEDING OF SOYBEANS TO LIVESTOCK

BY

C. W. HUDELSON

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ABSTRACT

The soybean is a native of southeastern Asia and has been grown in China, India, and Japan for more than 5000 years. It is the most important legume of those countries. Although the soybean was first introduced in this country in 1804 it is only within the last three decades that it has found an important place in American agriculture.

Summarizing, types of soybean feeds are as follows:

Soybean Pasture.—Soybeans as a pasture crop are not comparable to other legumes, rape, peas and oats or the grasses. The most satisfactory use as a pasture crop is for utilization when the crop is nearly mature and the beans are starting to harden.

Soybean Silage.—Soybeans can be made into silage successfully if allowed to dry in the field until the moisture content is reduced to 60 per cent. A more successful method is to mix alternate loads of soybeans and corn. Legumes, at best, however, do not make as satisfactory silage as corn.

Soybean Hay.—Soybean hay is about equal to alfalfa in feeding value and is ready to harvest the same season it is planted. A good grade of hay can be made from it at almost any time in its growth, but as the best hay comes from a small stemmed leafy plant, soybeans can best be cut not later than when the pods are small.

Soybean Straw.—Soybean straw in analysis seems to be only slightly lower in feeding value than timothy hay, containing five pounds less digestible nutrients per hundred pounds of feed. The nutritive ratio of the two feeds is about the same. Timothy hay is finer, of course, and usually will be eaten up cleaner.

Whole Soybeans.—Soybean grain contains about 36 per cent protein, 5 per cent ash and 17 per cent oil. The beans are not palatable to pigs and their protein and ash do not supplement the common farm grains well. If the beans are fed in sufficient amounts to balance a ration of corn for fattening hogs (about 20 per cent), the oil of the beans causes a soft pork.

Ground Soybeans.—Ground soybeans have been found slightly superior to cottonseed meal for milk production. In one instance where soybeans formed one-half the concentrate mixture for dairy cows, a soft unsatisfactory butter was produced. A smaller proportion should produce satisfactory results.

Soybean Oil Meal and Soybean Oil Cake.—Soybean meal is greatly esteemed by western dairymen and is an excellent protein-rich feed for swine. Soybean oil meal cake is fully equal to high grade linseed meal as a protein-rich concentrate.

Conclusions.—Soybeans furnish home grown protein feed which is an urgent need on every livestock farm. They yield well, therefore they are an economical feed.

Of the several forms in which a part or the whole plant may be offered the most popular and generally used are the hay and the oil meal. The classes of livestock that make the best returns on certain types of soybean feeds are: Dairy cattle, beef cattle, and fattening hogs on oil meal and cattle and horses on hay. The one main caution to observe is to take proper steps to avoid production of soft pork.

ECONOMIC BASES FOR PRESENT AND FUTURE PRODUCTION OF SOYBEANS IN ILLINOIS

BY

R. C. Ross

University of Illinois, Urbana, Illinois

ABSTRACT

The farmer's decision on soybean acreage focuses upon two economic considerations—relative profitableness, and the place of the crop in the farming system. During recent years improvement in varieties, cultural practices and harvesting methods have markedly increased yields, and the building up of a marketing organization has put the crop on a commercial basis.

The acreage of soybeans grown in Illinois has increased from 1,000 in 1914 to a peak of 771,000 in 1931. While some soybeans are now grown in all parts of the State, approximately 85 per cent of the acreage is located in a belt running east and west across the State, 175 miles in width from north to south. In the northern three-fifths of this belt, the part lying north of the Shelbyville Moraine, the acreage devoted to seed or grain production exceeds that used for hay, while the reverse situation is true in that part of the belt lying south of this line. Economically, the method of utilization is significant, since it marks the difference between use on the farm where grown and disposal through commercial outlets. As a grain crop, soybeans compete with other grain crops; as hay, with other hay crops. Relative profitableness of soybeans with other grain crops is shown by comparing the amounts of income above operating costs and taxes for various periods (Table 1).

TABLE I

Average Incomes per Acre Above Operating Costs and Taxes for Various Crops and Designated Periods Champaign and Piatt Counties[1] [3]

	10-year average 1923-1932	5-year average 1928-1932	3-year average 1930-1932	1-year 1932
Corn	$11.27	$7.95	$2.16	$—3.00
Winter wheat	9.52	6.75[2]	2.25	3.45
Soybeans (threshed)	6.83	5.49	— .18	.71
Soybeans (combined)	----------	9.03	2.70	4.86
Soybeans (hay)	----------	5.70	2.97	—1.72
Oats	4.43	3.33	1.26	.15

[1] Unpublished data and annual mimeographed reports, Department of Agricultural Economics, University of Illinois.
[2] Four-year average, 1929-1932. No records for 1928 due to winter killing.
[3] Incomes based on average market values for month of harvest.

Under recent price relationships, soybeans have an evident advantage which, however, is less obvious in the longer periods during which more normal price relationships prevailed. These figures also show one reason for the shift from binder and thresher to the combine in harvesting soybeans.

During short periods when economic conditions force every possible economy it is likely that the difference between direct cash outlay and cash returns becomes the immediate criterion for crop adjustments. Cash outlays

in growing corn, wheat, oats, and soybeans differ but little, hence the tendency is to favor the crop with the largest cash income. For the three-year period 1930-1932, cash incomes in Champaign-Piatt counties were corn, $14.13; wheat, $12.72; soybeans—threshed, $12.58, combined $13.37; and oats, $7.93. From the standpoint of profitableness, soybeans are bidding strongly for second place among grain crops.

In the farm organization, soybeans are widely adaptable. Their place as a direct income-producing crop has been shown; as an emergency crop they may replace winter-killed wheat as grain, or clover failure as hay. As a hay crop the operating costs are relatively high, yet with good yields, ton costs are not excessive. The present tendency to use home grown feeds and to defer liming programs favors expansion of hay production to meet farm needs. Commercial outlets for soybean hay have been but little developed.

Even in the heaviest producing areas of Illinois the ratio of soybean acreage to other crops suggests the possibility of much further expansion through replacement of lower profit crops. The much wider extension of the present commercial areas not only in Illinois but in other important producing areas indicates the possibilities of increasing the supply if prices warrant.

As yet, the demand is predominantly on the farms where grown. For the entire country, of the 1929 and 1930 crops, 56 per cent was cut for hay, 15 per cent grazed, and 29 per cent harvested for beans. Development of feed uses depends largely upon numbers of animals and feeding methods. Harvested beans have several outlets—crushing, seed, feed, export, and human food. While all of these may be expected to provide for expansion, the greatest possibilities doubtless lie in the broad and varied field of industrial utilization. The economic problem of determining the extent to which the potential physical production will be carried is that of developing commercial uses in sufficient variety and volume and an adequate marketing mechanism in order to return to the grower remunerative prices for the beans produced for market.

PAPERS IN ANTHROPOLOGY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

Six papers were presented before the meeting of the Anthropology Section. The following were not presented for publication:

"Pictorial Survey of Archeology in the Mound Area," by Thorn Deuel, University of Chicago, Chicago, Illinois.

"An Archeological Survey of Cahokia Creek East of Collinsville Bluffs," by W. H. Hunter, University of Illinois, Urbana, Illinois.

"Projected Research in the Archeology of the Ohio-Mississippi Confluence in Southern Illinois," by Bruce Merwin, Southern Illinois State Normal University, Carbondale, Illinois.

Attendance averaged twenty at the Friday afternoon meeting. Approximately seventy persons attended the field trip to Cahokia Saturday morning.

Mr. Thorn Deuel, University of Chicago, was elected chairman of the section for 1933-34.

(Signed) A. R. KELLY, *Chairman*

SUGGESTIONS FOR THE QUANTIFICATION OF POTTERY STUDIES IN THE LABORATORY

BY

FREDERICK R. MATSON, JR.

University of Illinois, Urbana, Illinois

As it is felt that objective descriptions would prove of value in describing the pottery of a district and would aid in the comparative study of pottery, the following suggestions are offered:

Body Composition.—The study of a thin section or a powder of a representative sherd with the aid of a petrographic microscope would not only indicate the physical composition of the body which, with most primitive pottery, approximates that of the unfired ware, but would also aid, together with the study of State Geological Survey bulletins, in the identification of the clay beds used. With this information it could be determined whether or not the non-plastic tempering material occurred naturally in the clay. The nature of the non-plastic material, the percentage present in the body, and the range of grain size might be determined either by means of the thin section or by an X-ray photograph of the sherd.

Texture.—The determination of the porosity of a ware would furnish a means of describing its texture, the coarser ware having the higher porosity. In reporting the surface texture of the sherds, a hard needle might be drawn over the surface under controlled conditions with its vertical motion amplified and recorded, the resulting curve then being mathematically analyzed.

Hardness.—Among the methods for determining hardness are scratching, grinding, boring, and pressure and impact tests. For pottery studies, Moh's scale of hardness which is used by mineralogists seems to be quite satisfactory. Where necessary, some intermediate minerals can be added to this scale to further limit it. As the "skin effect" of the surface of the pottery may greatly influence the hardness, the tests should be made on undamaged surfaces of sherds. The hardness of the sherd will give some indication as to the temperature to which the clay was fired.

Color.—There are many methods which might be used to define color or color variation in a sherd series, such as Munsell's color sphere with its three variables—hue, value, and chroma; a book of standard color shades; a color top; or a recording photo-electric analyzer which will automatically plot a color curve in less than a minute showing the amount of each wave length of light reflected from a surface when illuminated from a standard source. Although the analyzer would be the most accurate, the book of colors would probably be the most practical to use in studying sherds. A series of sherds selected from those found at a site might be used to illustrate the color variations in the pottery of that place, and to determine the percentages of the different colors found.

Density.—A statement as to the bulk density of the sherds would be a useful addition to a report.

If a series of objective standards were adopted by archaeological laboratories studying primitive pottery, the resulting uniformity of reports would greatly aid workers in this field.

A CLASSIFICATION OF CAHOKIA PROJECTILE POINTS

BY

P. F. TITTERINGTON

St. Louis, Missouri

ABSTRACT

The material here classified is from the surface of the camp sites which are located between the mounds. It represents the combined collections of three men over periods of twenty, fifteen, and twelve years respectively, and material secured from local farmers.

The 2523 arrowheads that can be classified range from ⅝ to 2⅜ inches in length; 1020 (40.4 per cent) are triangular and 1503 (59.6 per cent) are notched. Of the 1020 triangular points, 672 (65.8 per cent) have slightly convex sides, 252 (24.7 per cent) have straight sides, and 96 (9.5 per cent) have slightly concave sides; 958 (93.9 per cent) have straight and 62 (6 per cent) have concave bases.

Of the 1503 notched points, 1284 (85.4 per cent) are side notched and 219 (14.5 per cent) are corner notched; 1217 (94.7 per cent) have straight and 67 (5.2 per cent) have concave bases. In the side-notched points the head is rather wide. The group of corner-notched points includes all that do not have wide heads. Some of these should doubtless be classed as side-notched but since the heads are not rectangular, they are not included in the predominating group.

Of the total number of arrowheads, 211 (8.3 per cent) have a notch at the center of the base; 208 are side-notched. They are worthy of special note on account of the materials and workmanship. Fifty-one are translucent, a few being made of highly colored almost transparent agate, and the chipping is of the finest, the arrowheads being thin, well made and regular, most of them completely chipped on both sides. Only a few are made from flakes.

Most of the base-notched points (177) have one pair of side notches and are known locally as three-notched points. A few have more than one pair of notches. In the multiple-notched points the primary pair of notches is considerably deeper than the more shallow secondary pair or pairs. There are seventeen five-notched points with one pair of primary and one pair of secondary notches; five seven-notched points with one pair of primary and two pairs of secondary notches; two nine-notched points with one pair of primary and three pairs of secondary notches; and seven points so closely notched that they are classed are serrated.

Twenty-one points which have no base notch have one pair of primary and one pair of secondary notches (four-notched); four have one pair of primary and two pairs of secondary notches (six-notched). In all multiple-notched points, the secondary notches may be above, below, or above and below the primary notches.

Fifty-five of the triangular and twenty-five of the notched points (3.1 per cent of the total) are serrated. Ten points have a highly polished strip down the center of one side. This polish is the same as that seen on bits of agricultural implements and suggests that they might have been made from chips from these implements.

The number of arrowheads is being increased each year. The collection is open for study and it is hoped that some time an archeologist will make a more scientific classification.

ON THE INVESTIGATION OF THE SECOND POWELL MOUND

BY

R. H. Bray

University of Illinois, Urbana, Illinois

ABSTRACT

This report discusses briefly an attempt to apply soil chemistry to the study of the mound structure of the second Powell Mound. The work was done in cooperation with Doctor Kelley of the University of Illinois.

The main feature of this mound was a dark-colored, fine silty clay soil material making up the bulk of the mound which rested on a natural sand base. This was covered by a shallow sandy material, not included in the investigation because of its disturbed condition. The soil material has been undisturbed since it was laid down, except in the dyke formations found cutting through the mound. Vertical samples from the top to the base of the undisturbed soil material were taken for study. A slight columnar structure had developed in the upper part of the soil material.

The replaceable base content of the whole profile varied from 20 milliequivalents per hundred grams of soil in the surface to 22 in the soil just above the sand floor. The pH for the whole profile was around 7.0. This shows no leaching profile but is evidence for the original uniformity of the whole soil material. This uniformity makes possible the interpretation of the organic-matter study.

The organic nitrogen content showed a variation with depth from 0.086 per cent nitrogen in the top of the soil material to 0.113 per cent in the bottom of the soil material. The organic carbon varied similarly.

This is the reverse of a regular soil profile and is chemical evidence that the mound was built up by man and has since weathered to form the organic-matter curve found. This organic-matter curve is a result of many factors, among which time is of greatest importance. Although no definite length of time can be associated with this one curve, there is a possibility that relative age can be established on mounds built of fairly uniform material by comparing the nature of the curves obtained. The careful vertical sampling of mound material as a regular part of mound study is recommended.

The question as to whether the dyke formations were recent or not has been raised. If recent, the organic matter curve for a vertical sampling of the dyke material would be erratic. If they were cut through the mound shortly after the mound was built this curve would follow the curve of the undisturbed portion of the mound. Unfortunately no dyke samples were taken.

This emphasizes the importance of taking vertical samples from all structural features within the mound.

Papers In Botany

Extract From the Report of the Section Chairman

Twenty-two papers comprised the program of the Botany Section. A number were withdrawn from publication, some being of such a nature that they did not lend themselves readily to abstracting and others requiring illustrations. They are as follows:

"Additions to Flora Peoriana," by V. H. Chase, Peoria Heights, Illinois.

"Rust Observations in the Illinois Winter Wheat Areas in 1932," by Kenneth Wright, Bloomington, Illinois.

"A Comparison of the Size Range and External Characteristics of the Spores of Modern and Fossil Lycopods," by Orrin J. Henbest, University of Illinois, Urbana, Illinois.

"Pollen Analysis of Some Water-deposited Sediments," by P. K. Houdek, Robinson, Illinois.

"*Primula mistassinica* in Illinois and the United States," "Unique Plant Distribution," and "Apple River Canyons," by H. S. Pepoon, State Natural History Survey, Urbana, Illinois.

"The Skunk Cabbage in Winter," by Jesse L. Smith, Highland Park, Illinois.

"Forest Distribution in Crawford County," and "Tree List for Crawford County," by S. Ray Bradley, Robinson, Illinois.

"False Indigos of the Mississippi Valley," by J. M. Greenman, Missouri Botanical Garden, St. Louis, Missouri.

"Three Fungal Species Parasitic Upon Algae," by Myrtle M. Burk, University of Illinois, Urbana, Illinois.

"Development of Zinnia under Soil Moisture Control," by Charlotte L. Grant, University of Illinois, Urbana, Illinois.

Average attendance at the meeting was forty, maximum was sixty.

Mr. E. L. Stover was elected chairman for 1933-34.

(Signed) H. S. Pepoon, *Chairman*

RESISTANCE OF FUNGOUS SPORES TO LOW TEMPERATURES

BY

CONST. J. ALEXOPOULOS AND J. DRUMMOND

University of Illinois, Urbana, Illinois

The study of the effects of very low temperatures on lower plants has been mainly limited to bacteria and yeasts. In 1902, Macfayden and Rowland (*1*) exposed some yeast cells and several types of bacteria to liquid hydrogen temperatures (about -252° C.) for a period of six months. In no case was the vitality or the physiological properties of the micro-organisms impaired by such treatment. Tanner and Williamson (*3*) and Tanner and Wallace (*2*) cite other experiments in which the resistance of bacteria and yeasts to low temperatures was shown. Experiments by Tanner and Wallace (*2*) with *Clostridium botulinum* indicated that spores of this organism are able to withstand freezing at -16° C. for a period of fourteen months. On the other hand, Tanner and Williamson (*3*) have shown that prolonged action of freezing temperatures destroys certain yeasts and bacteria.

The writers undertook experiments to determine the resistance of fungous spores to liquid air temperatures (about -185° C.). The organisms used were: *Melanconium fuligineum* isolated from Grape, *Coniothyrium* sp. isolated from Elm,[1] *Eurotium herbariorum*, culture obtained from C. V. S., Baarn, Holland, and *Cytospora chrysosperma*, isolated from Willow.

Several methods of subjecting the spores to liquid air temperatures were employed: 1) A suspension of spores in sterile water was placed in a test tube and the latter immersed in liquid air; 2) spores were inoculated on a corn meal agar slant and the tube immersed in liquid air; 3) a sterile glass rod was dipped into a sterile water suspension of spores and after the water was allowed to evaporate the glass rod was immersed directly into the liquid air. All three methods were employed with each of the organisms used and controls were maintained in each case.

After an hour's exposure to -185° C. the spores were brought to the laboratory and inoculations were made on corn meal agar with spores taken from the water suspension and from the glass rod. In all cases, germination of the spores and normal growth took place, the colonies resulting from frozen spores being in all ways similar to those resulting from untreated spores.

There were some indications that the mycelium of certain fungi was fatally injured by exposure to liquid air temperatures, transfers made from treated mycelium failing to grow. Experiments will be continued with both spores and mycelium and the results will be reported later.

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(*1*) MACFAYDEN, A., and ROWLAND, S., On the suspension of life at low temperatures, Ann. Bot., 16:589-590, 1902.

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(*3*) TANNER, F. W., and WILLIAMSON, B. W., The effect of freezing on yeasts. Proc. Soc. Exp. Biol. and Med., 25:377-381, 1928.

[1] Isolated by Mr. H. Harris of the Illinois Natural History Survey, whom the writers wish to thank for supplying them with a culture of the organism.

SCIENTIFIC BOTANICAL DESIGN

BY

EMMA C. CRUMMER

Chicago, Illinois

Scientific Botanical Design is a three-fold subject: science is classified and established knowledge—comprehensive information; botanical pertains to plants and trees; design means to plan, to purpose. Then scientific botanical design must be something upon which we may depend as being true facts from the field of botanical research, and as designers we find our patterns for designing purposes.

It is one of the erroneous beliefs that there is always a conflict between science and art. One of our great masters in science has taught us that "Science leads—Art follows."

The designer's job is to create something beautiful. The field of scientific botanical research is wide open to the artist who is indeed welcome, because he has demonstrated that he has found what he was seeking in science, and is using it in art.

It has been said by some of our scholarly educators that "some day we shall be looking for God in our laboratories." That "some day" is here now. Out into the field we go, among the things which God has created—to find the Creator. There we shall learn that the Creator is greater than the thing created.

How may we use this new discovery? It is to be the foundation of a new school of scientific art and industry where students are free to experiment in science and art.

The old masters in art experimented in doing things in new ways, hence they became masters; and a master is one who has mastered something for human use and enjoyment. Moreover, he must be a pioneer, who can give convincing proof that he has worked out a method, a system, and a course of procedure, all in obedience to natural laws which he has learned from diligent study from the pages of "Nature's Book of Ornament" giving logical reasons for certain rules which are to be followed whereby the designer may create something original and scientifically beautiful.

It is very important where the patterns are obtained in nature as this, in a large degree, determines the quality and value of the design.

The author has learned by experimenting that fundamental laws will guide the designer in testing his work, which can only be gained by systematic training and a workable knowledge of his subject, namely, the internal plant morphology, from the viewpoint of the two-fold mastery, which must be both Botanist and Artist.

Here, too, is a wide field for the geologist and the chemist in experimental research to discover more truth in color harmony; seeking scientific ideas and how to use them.

FLOWER VARIATION IN ZINNIA

BY

CHARLOTTE L. GRANT

University of Illinois, Urbana

During an experimental investigation on the development of Zinnia under three soil moisture ranges—wet, moist and dry—certain flower variations were observed.

According to catalog description the Red Riding Hood variety of Zinnia possesses double flower heads with scarlet rays. This description should certainly apply to the terminal head of the main stem, and according to reported observations to branch flowers as well. In twenty-three greenhouse plants of this variety none showed scarlet rays in the axial head (at the top of main stem), and only two plants gave consistent orange color in all the flowers developed on one plant. In all other plants, different flower heads had different colors although never more than one color to a particular flower head. As many as four different colors have been found among the flowers of a single plant. Fourteen colors have thus far been found on the twenty-three plants.

Microscopic examination of freehand sections of the rays showed a distribution of color in the following manner: orange or yellow chromoplasts in the upper papillose epidermis, red pigment dissolved in cell sap, present in varying amounts or entirely lacking in the upper epidermal cells; chloroplasts abundant or few in the mesophyll. Thus, yellows with a greenish cast were due to an abundance of chloroplasts in the mesophyll. Scarlet ray color results from a combination of red sap (apparently dilute spectrum red) with orange chromoplasts. Apparently the influence of the chromoplasts is less than might be expected. The various shades of orange depend upon abundance of chromoplasts in the upper epidermis and chloroplasts in the mesophyll.

Some variation in doubling was apparent and in six heads disc flowers were wholly lacking. But excluding from consideration these variations one is puzzled to account for the presence of differently colored flowers on a single plant. Is this an inherent variation involving genetic differences originating in the buds which produce the several axillary branches with their terminal flower heads? Can it result from the rather peculiar environmental conditions? Can it be an expression of difference in carbohydrate nutrition for the several branches on a plant? Or can it be a combination of several of suggested influences?

The lack of uniformity in color of heads on the same plant, and among plants of the same environmental series together with absence of correlation between sequence of development of heads on one plant with change in color are indications of inherent variation within the individual plants. On the other hand the frequency of color variation is many times higher than is characteristic for somatic mutations.

The soil used, a sandy loam of pH 5.3 was found low in phosphates and nitrates. This might be considered a possible environmental influence on flower color. But if soil conditions are unfavorable to normal color development why should not all the flower heads of a plant develop alike?

CONSERVATION OF WILD FLOWERS AND SHRUBS A MUNICIPAL DUTY

BY

L. F. GUMBART

Macomb, Illinois

Our native wild flowers are fast becoming extinct because people who love them will not let them grow and mature seed. Native shrubbery is fast following the flowers, in spite of the fact that brush holds the hillsides and stops erosion. Encourage the hazel, the wild-crab, plum, the red and black haw, persimmon, sassafras, the prickly, aromatic, and paper ashes, the service bush and red-bud, the wahoo or spindle bush, the gooseberries and blackberries and the wild roses in the draws and washes and plant hickory, walnut, pecan, oak and the conifers on washed off knobs and give nature a chance to take care of some of her own flood control problems.

Just now when the early wild flowers are blooming we must not forget that many varieties are fast disappearing. As a general rule, of the early spring flowers only the violet and cranesbill should be plucked or transplanted in town. Most of the summer and fall flowers seed freely and so may be picked generously. Following is a list of some of the flowers which we should encourage in our wild parks by carefully planting such as are not already there: Hepatica, anemone, wind-flower, spring-beauty, buttercup, blood-root, yellow-puccoon, wake-robin, purple trillium, blue-bell, dutchman's breeches, may-apple, sweet-william, dogtooth violet, shooting star, jack-in-the-pulpit, pansy, hare-bell, solomon's seal, lady's slipper or moccasin flower—all spring flowers—and I must not forget the old prairie or Turk's cap lily, now seldom seen.

May we not all go back to our home town and if there is no wild park, check up on some available rough land, say twenty to a hundred acres, buy it as a community or induce someone to buy or donate it for the town! Clear a few level spaces for picnic, ball, and tennis grounds. Turn it over on honor to the boy and girl scouts or high school to rule and regulate. Give continued instruction and care toward developing a real nature's garden of ground flowers, tangled vines and shrubbery for the birds. When available, a good spring or brook is an added attraction, but good potable drinking water must be provided. A good substantial fence is the next consideration, then clean toilet arrangements and an open building of steel construction with sheet steel corrugated roof large enough to cover a good sized crowd should a storm arise. If the town has no large auditorium, consideration might be given the possibility of using this building for Chautauqua, politics, young folks conventions, 4-H work, etc. By all means, do not combine it with a tourist park.

Uncle Sam has national parks, Illinois has state parks, Cook County has forest preserves and beautiful parks and playgrounds. Why not a wild park and playground near every city and town in the State to help perpetuate the many beautiful native plants, shrubs, and trees and aid us all to know and appreciate the outdoors and what nature reveals to us of God and His wonderful works for the children of men.

LATE WINTER INJURY OF SOME COMMON TREES AND SHRUBS

BY

HUBERT A. HARRIS

State Natural History Survey, Urbana, Illinois

ABSTRACT

During the latter part of February, 1932, temperature conditions throughout Illinois were so mild that growth activities were initiated precociously in different kinds of trees and shrubs. Early in March, however, a sudden freeze occurred which seriously injured vegetative growth.

In the Champaign and Urbana vicinity the effects of winter injury ranged from slight to very severe. Among those woody perennials most seriously injured were elm, pussy willow, poplar, and privet.

The most conspicuous and common symptom associated with winter injury was the presence of numerous dead, bare twigs or small branches protruding either from the tops of injured trees and shrubs or occurring at the ends of lower lateral branches. Quite frequently portions of larger branches manifested the same dead and leafless appearance. The extent of dying back ranged from only a few inches to as much as several feet, in accordance with the particular species of plant.

Another common and striking characteristic of the winter-injured plants was the presence of much enlarged or partially opened buds killed by freezing. Buds of the most precocious trees and shrubs were fully opened when killed. Those woody perennials characterized by a more retarded growth showed only swollen or partially unfolded buds, while buds on other plants with a still more prolonged period of dormancy, were only slightly enlarged and had been killed, apparently, just as growth activities were being initiated.

The American elm (*Ulmus americana* L.) commonly suffered winter injury during the spring of 1932. The occurrence of an exceptionally dense or compact foliar growth immediately below the winter-killed twigs and branches was a conspicuous character manifested by severely injured elms. Such leafy growth originated from the premature development of buds normally developed at the bases of already expanded leaves. Ordinarily these buds would have remained dormant until the following spring.

The cultivated pussywillow (*Salix caprea* L.) was so commonly injured that very few instances were observed in which no serious effects of freezing were evident. Injury was most noticeable among the flower branches though some lower laterals were also injured.

Winter injury to poplar was also quite general and extensive. The Lombardy poplar (*Populus nigra* L. var. *italica* Du Roi) was more extensively injured than the White (*P. alba* L.), Carolina (*P. canadensis* Moench.), or Simon (*P. simonii* Carr.). Greater injury to the Lombardy poplar was due not only to its more general cultivation, but also to the fact that the tree is usually grown singly, or in rows, quite isolated from other trees, and left unsheltered.

The common privet (*Ligustrum vulgare* L.) suffered extensive, though only moderately severe, winter injury. In most instances no large portions of the plants were killed, but instead, it was of more common occurrence for numerous small twigs scattered throughout the bush to be killed.

Most noticeable among those trees and shrubs injured to a lesser extent was the hard maple (*Acer saccharum* Marsh.)

MATERIALS FOR DEVELOPING THE TECHNIQUE OF CONSUMPTION FOR FOODS

BY

M. Faith McAuley

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The studies that have been made of our food crops have been concerned chiefly with problems of production and distribution. Techniques of production have been worked out for all of our leading crops and the technical information is available to anyone interested. In distribution, too, techniques have been developed.

The consumptive activity has received little attention to date. The consumer has only recently been recognized as an important factor in our economic scheme and production and distribution considered in terms of consumption. The education of the consumer is still left almost wholly to competitive commercial interests and is accomplished through the medium of modern advertising. This method is expensive, characterized by half truths and economic shortsightedness.

The intelligent buying of food is not only important, it is also difficult. Our food stuffs are many and varied and their purchase presents more difficulties than does the purchase of materials satisfying other human needs, such as clothing and shelter. Much technical knowledge covering a wide range of products is needed.

Many of our food products, even the most perishable, are raised in distant producing regions, brought to us by special transportation such as fast freight, express, and refrigerator car. They are held for delayed consumption in cold storage or are preserved for indefinite periods by drying, canning, freezing. Each new process leaves the consumer less well-informed concerning his food products and makes acquiring of new knowledge necessary.

Materials for developing the techniques in food consumption should furnish, as a background, information concerning the methods of production or manufacturing which have a bearing on consumption and the marketing machinery which brings the product from distant producing regions. Certain specific information concerning the product is needed such as: the chief producing regions; the volume of production; the peak of production; the season when available and when most abundant; varieties with quality; grades and the brands descriptive of such grades; standard packages with volume or weight; quality and value as distinct from appearance and price; and the special uses for which the product is suited.

The importance of definite information in regard to the season can be illustrated by cauliflower. Cauliflower, the variety *botrytis* of the cabbage group, is a plant requiring abundant moisture and cool temperature for the production of marketable stock. It shows a definite climatic response with the heaviest production in January, a lesser production in the Fall and Spring and a very small production in June, July and August. The intelligent placing of consumer demand is therefore very clear.

Spinach is another crop with clearly marked seasonal availability. The four chief producing regions are Texas, Virginia, Maryland and South Carolina, with Texas and Virginia the heaviest producers. The three winter months are the months of heavy production with no shipments in June, July and August. The ecological factor of temperature is well shown; spinach, heat intolerant, is produced in the winter in the truck gardens of Texas and the South Atlantic states. In the northern states, the summer season is

too hot for the production of spinach, and the period suitable in Spring and Autumn is too short to produce more than a small and uncertain supply. Spinach is, therefore, a vegetable to be used when most available, namely in January, February, March, rather than in June.

Materials of this nature the writer feels, would, if made more generally available help in developing a technique of consumption.

ANATOMY OF THE XYLEM OF *SCIADOPITYS*

BY

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ABSTRACT

This investigation was undertaken with the intention of presenting a complete anatomical study of *Sciadopitys*, from which it is hoped new light may be thrown on its phylogenetic affinities. The anatomy is revealed as being quite simple, with but two notable exceptions: the absence of a resinous system is paralleled only in five species of *Abies*, and the absence of end-wall pitting in ray cells is not known in other conifers. The presence of resin canals and resin cells in tissues of the cone axis other than xylem suggests interesting corroboration of Jeffrey's theory concerning the evolution of these organs. Extremely primitive manifestations are found together with others equally advanced. Taking a phylogenetic view of the sum of anatomical characters, it is assumed that *Sciadopitys* is not closely related to any known conifers. Its evolution apparently involves somewhat remotely both the Abietineae and Taxodineae, but not the heterogeneous Cupressineae.

PERSISTENCE OF SUBSPECIFIC TYPES OF *XANTHIUM* IN THE FIELD

BY

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ABSTRACT

Attention is called to the unhappy situation in the taxonomy of the genus *Xanthium* caused by the disagreement between recent monographs on this group. Evidence is presented to show that some of the forms which are considered of sub-specific rank by the monographers are capable of maintaining themselves as distinct entities under field conditions.

The species described some years ago as *X. globosum* and included under this name in Millspaugh and Sherff's[1] monograph, was grown a number of years, and maintained itself as a distinct form. Widder[2] considers this species a form of *X. pungens*. Evidence in regard to variability in seed size in *X. globosum* and *X. pungens* indicates that the two are quite distinct. In length, breadth, and weight of seeds, color of seed coats, time of blooming, color and armature of burr these two are distinct enough to retain *X. globosum* as of species rank.

Another form of sub-specific rank, *X. chinense globuliforme*[3] has been maintaining itself under field conditions for six years, and seems capable of becoming an independent and permanent multiple seeded form of *Xanthium*. There has never been any apparent tendency for it to split up into other forms. It is very prolific, and all plants are fertile. Volunteer plants propagate it year after year without difficulty. In nature it could become a very persistent weed.

A third sub-specific type is *X. pennsylvanicum laciniatum*[4] which was discovered by the late Mr. Crevecoeur of Onaga, Kansas, several years ago. These laciniate forms have been maintaining themselves by volunteer propagation, and 100 per cent of the offspring came true to type in a test embracing nearly 400 individuals. There was no evidence of hybridization, and the laciniate type of leaf seems fixed in this form.

The origin of these sub-specific types is not known. They have arisen suddenly as if by mutation, although the multiple seeded form may be of hybrid origin. But they are apparently not any less stable than those forms that are regarded as true species, and can maintain themselves unaided in the field. Such forms raise the question as to what constitutes a species, and as to what constitutes good taxonomy, that which concerns itself only with dried herbarium specimens, often immature, or that which gathers evidence of stability and presistence in nature on the basis of breeding and field tests. Certainly those forms that cannot persist and remain stable in character should not be called species; those that arise in nature, which can and do persist, and remain permanently stable seem worthy of consideration as true species.

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[1] Millspaugh, C. F., and Sherff, E. E., Revision of the North American species of the genus Xanthium. Field Museum of Natural History Pub. no. 204. 1919.

[2] Widder, F., Die Arten der Gattung Xanthium. Repertorium specierum novarum regni vegetabilis. Beih. Bd. XX Berlin. 1923.

[3] Millspaugh, F. C., and Sherff, E. E., Xanthium. North American Flora 33 :37-44. 1922.

[4] Sherff, E. E., New or otherwise noteworthy Compositae. Bot. Gaz. 92:202-209. 1931. (See pp. 208-209.)

GRASSLAND IN THE FLOODPLAIN OF ILLINOIS RIVERS

BY

LEWIS M. TURNER

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The occurrence of grassland in the floodplain of the larger rivers in or bordering Illinois has been discussed by Brendel (1887), Gleasan (1910), Imlay (1797) and Sampson (1921). The relationship of this type of grassland to bottomland forest and other vegetation types in the Mississippi and Illinois river valleys seems to be as follows: the customary floodplain forest is commonly confined to a belt or zone from a few hundred yards to a half mile in width paralleling the river channel or surrounding ponds and lakes. The landward side of this forest type merges into a grass association, at first on the hydric side of mesophytism, but giving way in turn, as the elevation of the floodplain increases, to a mesic grass association.

Two such areas were studied in the summer of 1930, in the Mississippi floodplain near Hillview, and the Illinois River floodplain northeast of Kampsville. An analysis of the site factors of these situations did not reveal striking differences between these areas and similar prairie areas in the middle western states, except for occasional flooding.

The spring floral aspect of these areas is characterized by the early vegetative phase of the grasses and the few sedges that will later dominate the situation. In addition are a number of early blooming spring flowers as Cerastiums, Veronicas, Stellaria, Specularia, Amsonia, Ranunculus, Myosurus, Erigerons, Potentilla, Apocynum, Sisymbrium and Arabis. Two grasses, Alopecurus and Festuca are identifiable and Eleocharis is fairly common.

Midsummer finds the following plants important in the habitat: *Spartina Michauxiana*, Bidens species, Cassia, Ambrosias, Iva, Apocynum, Steironema, Vernonias, Oxalis and Euphorbias. By this time Spartina, *Panicum virgatum* and *Calamagrostis canadensis* have attained such size as to be the dominant, conspicuous plants.

A statistical survey, conducted in early September revealed the following floristic character of the prairie: *Spartina Michauxiana* is conspicuously dominant in both areas. *Panicim virgatum*, although having a spotted distribution is locally important to the point of dominance. *Elcocharis palustris* and Carex species are relatively important. Both areas have also a representation of dicotyledonous plants, as *Lythrum alatum*, *Cassia Chamaecrista*, *Bidens trichosperma*, *Ambrosia bidentata*, *Iva ciliata*, *Eupatorium serotinum*, and *Oxalis corniculatus*.

In many ways these areas resemble some of the stages in prairie succession as occurring in the Mississippi floodplain near Savanna, Illinois (Sampson, 1921). However, in this instance clear-cut steps in succession were not discernible, conversely there occurred an abundance of overlapping of stages.

The method of statistical analysis employed was that derived by Raunkiaer (Raunkiaer, 1918). The frequency curve of the areas in question essentially coincided with the curves derived by other investigators elsewhere. However, the results obtained more nearly approximated Kenoyer's curve

(Kenoyer, 1927) in the Chicago region, than other areas described by other investigators.

Literature Citations

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Kenoyer, Leslie A., 1927:
A study of Raunkiaer's Law of Frequency. Ecol. Vol. VIII. No. 3.
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Recherches statistiques sur les formations vegetalis. Det. Kgl. Danske Videnskabens Selskab. Biologische Middel, 1:3. Kobenhaven.
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An ecological survey of the prairie vegetation of Illinois. Bulletin of the Illinois Laboratory of Natural History. Vol. XIII, Art. XVI.

Papers In Chemistry

Extract From the Report of the Section Chairman

The Chemistry and Physics sections held a joint session at which three lecture-table demonstrations and two papers were presented, after which the groups separated for their section meetings.

Of the eight papers on the Chemistry program, only five are here represented. The others were:

"Activity Coefficients of Hydrochloric Acid," and "Pressure in Bubbles," by T. F. Young, University of Chicago, Chicago, Illinois.

"The Value of Valence and When to Teach It," by E. E. Rademacher, Nokomis.

Mr. Fred A. Dykins, State Highway Division, Springfield, was elected chairman for 1933-34.

(Signed) George C. Ashman, *Chairman*

LECTURE TABLE DEMONSTRATIONS

BY

CHAS. T. KNIPP

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LIQUID OXYGEN

Abstract.—This paper has to do with the liquefaction of oxygen as a lecture table experiment. The apparatus consists of a single bulb (pyrex) and the operation need last but 30 seconds and yet results in the formation of 2 to 3 cc of liquid. The process may be projected on a screen.

A NEW EXPERIMENT SHOWING THAT CATHODE RAYS LEAVE THE CATHODE SURFACE NORMALLY

Abstract.—This fact is so well established that a suggestion of an experiment to show it seems trite. The cathode is a cylinder around which are placed a number of rings of wire equally spaced. These wires are conductors yet they cast distinct shadows on the walls of the discharge tube. The experiment is novel and at first perplexing yet easily understood. To make the phenomenon visible throughout the room the vessel is primed with helium.

A RECTIFIER HAVING COLD ELECTRODES

Abstract.—When one refers to rectifiers we at once think of discharge tubes having a hot cathode. This new rectifier makes use of the principle, established years ago by Hittorf, that in order for a current to pass through a discharge tube the electrodes must be so located that the Crookes dark space can form freely. By preventing this in the case of one of the electrodes, in a simple discharge tube, and placing this tube in series with the secondary of, say, a ½ kilowatt transformer, the resulting high potential alternating current may be rectified. Experiments showing an alternating and a rectified discharge through a vacuum tube will be performed.

THE MAGNETO-OPTIC METHOD OF ANALYSIS

BY

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ABSTRACT

The magneto-optic method of analysis which has been devised by Professor Fred Allison depends upon the fact that when a water solution of an inorganic salt is subjected to a magnetic field it rotates the plane of polarized light (Faraday effect). When the magnetic field is applied there is a brief time interval before the Faraday effect can be detected. The length of this lag depends on the nature of the material in solution. If it is possible to measure the extremely short spaces of time which represent the differences in the lag, then it ought to be possible to use these differences as a means of chemical analysis.

The apparatus includes a light source such as a metal spark. This light is polarized by a Nicol prism and passes through two tubes which are surrounded by oppositely wound coils of wire. Behind the second coil is placed another Nicol prism, the two prisms being "crossed" so that a minimum of light emerges at the zero position. The two tubes are filled with different liquids, and the second coil is moved a short distance away so that the light is compelled to travel a slightly longer path and hence delay for a fraction of a second the effect of the magnetic field. By careful adjustment the delay caused by the increased light path may be made to coincide with the Faraday lag and at this point a minimum of light emerges. By noting the position of these minima, it is found that each inorganic salt has a minimum for each of the isotopes of the metal. This apparatus is therefore a device for measuring the time required for light to travel a distance of a few millimeters.

The method is extremely sensitive since the minima persist even when the solution contains only a slight trace of solute. Roughly, it should be possible to detect a single drop of brine in 100,000 barrels of pure water.

It is to be expected that any method which is so extremely sensitive might easily mislead an observer. Accordingly results on the magneto-optic apparatus have been carefully checked against standard methods such as the arc spectra, the absorption spectra and X-ray spectra with satisfactory checks in every case. We believe that in the hands of a careful, well trained observer the method can be depended upon to give accurate results.

Its advantages are: (a) extremely small quantities can be detected; (b) complex mixtures can be analyzed without separating the constituent materials; (c) the analysis is possible with a minute sample; (d) there is almost no loss of material; (e) the apparatus is moderate in cost; (f) the method may be adapted within limits to both qualitative and quantitative work.

The great weakness in the method under present conditions is the uncertainty on the part of various observers in detecting the minima. If a photoelectric cell could be brought into use or a photographic record made the large personal equation would be eliminated and the method would find many useful applications.

A STUDY OF BOILER WATERS IN HIGH PRESSURE PLANTS*

BY

D. B. KEYES

Chemical Engineering Division,

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ABSTRACT

The occurrence of calcium sulfate scale in ordinary boiler operations, the common practice of treating the water in order to prevent the formation of this particular compound, and the conditions of its formation in the ordinary boiler operating at 250 pounds pressure is well known.

High pressure boilers up to 2,000 pounds pressure have been recently constructed in this country and abroad. The higher efficiency of operation has caused considerable interest in these particular plants. Unfortunately, no data are available on the solubility of calcium sulfate under the new conditions, the solubility of many other salts present in ordinary boiler waters, or the effect of one soluble salt on another. The problem of operation at these high temperatures and pressures becomes a serious one. Work was started in the Chemical Engineering Division at the University of Illinois some years ago in order to ascertain the solubility of all these salts under these new conditions, and the effect of one upon the other.

It is realized that scale formation under high temperature conditions is likely to materially retard heat transfer and cause a hot spot in the metal and the failure of the tube or drum due to the high pressure. Such failures are likely to be disastrous, not only from the standpoint of property damage but also from the standpoint of loss of life.

The preliminary results of these tests, as far as calcium sulfate scale is concerned, indicate that the use of a small amount of soda ash will prevent the formation of calcium sulfate scale at high temperatures and pressures, and at the same time sufficient sulfate ion can be maintained to prevent embrittlement of the boiler plate.

In conclusion, it may be said that solubility studies at high pressure and high temperature will not only be valuable from the standpoint of the power plant operator but should supply data which will be of real use to everyone who is attempting to remove salts from water solution and who can utilize both high pressure and high temperature.

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* This work was done by Professor F. G. Straub of the Chemical Engineering Division, Engineering Experiment Station, University of Illinois. The work has had the financial support of the Utilities Research Commission Incorporated, of Chicago, Illinois. Further details of the work have been published in the Transactions of the American Society of Mechanical Engineers, *54,* (21) 221, Nov. 15, 1932.

EVALUATING A HIGH SCHOOL CHEMISTRY COURSE

BY

JOHN C. CHIDDIX

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Since the ultimate effect of the teaching upon the student is of most importance, the student's opinion of what is interesting and valuable in his general education should be considered.

To obtain the student's evaluation of what he studies, a questionnaire was prepared which listed 46 different learning elements, achievements and activities commonly included in the high school chemistry course. Each student in ten different high schools of cities having populations from 1000 to 100,000 was asked to judge each item as to whether it was interesting and as to whether it was of general educational value in later life.

Abstract ideas, it was found, are not interesting and are usually not recognized as of much value, especially if they are difficult to comprehend. For example, the theory of atomic structure and its relation to chemical activity was rated very low in both interest and educational value. How laws are derived was considered of interest by only 30 per cent and of educational value by 23 per cent of all the students. Determining the weight of a metal that would replace one gram of hydrogen ranked 32 per cent in interest and 42 per cent in educational value.

The data showed that what appealed most either applies to life directly, provides purposeful activity, or explains the nature of chemical activity. The students considered it very interesting and still more valuable to learn of the elements and compounds essential to plant and animal life, to learn of some of the chemical processes in the animal body, and to learn of the chemistry related to the home. Taking trips to local industries was considered very interesting by 94 per cent of all the students, and 89 per cent considered it of great educational value. Doing projects was interesting to 80 per cent of all the students, while 62 per cent thought it educationally valuable.

Learning that clarifies the nature of chemical action is also desired by students. For example, 68 per cent of the students were interested to know that when two elements were united chemically, the compound formed has entirely different properties from either of the two elements thus uniting, while 58 per cent believed it of educational value. Again, 74 per cent thought it was both interesting and valuable to know that matter cannot be destroyed, even by burning, but that it can be changed in form into a different substance.

The uses of the elements and compounds and the properties that make them useful appeal to the students of all the schools. The uses were rated as interesting by 75 per cent of the students and as educationally valuable by 87 per cent.

In the light of the above data the teacher should associate the necessary abstract material as closely as possible with actual problems of his students' experience. Learning elements can be made to appeal to students by presenting them through projects, studies of local industries, or other activities of interest to students.

SIRUP FROM JERUSALEM ARTICHOKES

BY

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ABSTRACT

Levulose, the finest and sweetest of all sugars, is available in polymerized form in the tubers of the Jerusalem artichoke (*Helianthus tuberosus*). The commercial development of levulose has been advocated both as a supplementary source of food and for the production of sugar in regions in which sucrose production is not permissible. The peculiar physical properties of levulose, its higher sweetening power and the distinct flavor will enable its use for purposes for which other sugar products are unfitted. The Jerusalem artichoke, being of a hardy nature, is adaptable to a wide variation of soil and climate and sometimes may serve as an important source of this sugar. This investigation had as its object the production of a palatable sirup from these tubers, the difficulties attendant to the crystallization procedure being reserved for future study.

The tubers, upon reaching maturity, are washed, sliced and dried, and the dried material is used for the preparation of the sirup. An extract is prepared by diffusion in the regular manner in a six cell diffusion battery. The principal scientific interest centers in the method of hydrolysis of the solution of the polysaccharide material. A study of various combinations of the reaction time, temperature, degree of acidity and concentration of solids in the extract was necessary before optimum conditions for the reaction could be established.

Following the experimental work in the laboratory, the process selected was adapted to a semi-plant scale. The operations are essentially as follows. The extract of 30–35 per cent total solids as obtained from the diffusion battery is filtered with the aid of Super Cel using a small Shriver filter press. It is then acidified with HCl to a pH of 4.2 and transferred to a copper converter having a capacity of about 40 gallons. Steam is introduced directly into the reaction mixture until a pressure of 25 lbs. is reached. This pressure is maintained for about 20 minutes after which the solution is blown off. The converted extract is transferred to a glass lined evaporating pan and concentrated under diminished pressure to 50–60 per cent solids. After withdrawal of the sirup from the pan, it is neutralized with sodium carbonate to a pH of 5.4 and then filtered through active char (carboraffin) to reduce the color. Finally it is evaporated in the vacuum pan to a solids content of about 82 per cent.

The resulting sirup has a color ranging from a light yellow to a dark reddish brown. The taste varies somewhat depending upon the character of the original dried material, the conditions of evaporation, and the extent of active char treatment. In the present form the product is recommended chiefly for table use and for cooking in which a colored sirup is permissible.

THE ELECTRODIALYTICAL PROCESS AS A METHOD FOR ACIDIFYING AND PURIFYING POLYSACCHARIDE SOLUTIONS

BY

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Research work having as its ultimate goal the preparation of a palatable syrup from the tuber of the Jerusalem artichoke (*Helianthus tuberosus*) has been in progress at the University of Illinois for several years. However, in the preparation of such a syrup two problems are of considerable importance: (1) the conversion of the polysaccharides contained in artichokes (inulin and various levulins) into simple sugars, and (2) the removal of undesirable non-sugar material which also occurs in the tuber.

Since certain difficulties are inherent in all of the conventional methods of solving these two problems, the possibility was investigated of accomplishing by one process both the acidification of the diffusion-battery extract obtained from artichokes, which acidification is necessary to effect conversion of the polysaccharides to simple sugars, and the removal of at least part of the non-sugar material in it. This process is based on the phenomenon of electrodialysis, which may be defined as the migration through diaphragms of ions under the influence of an electrical potential.

The extract containing, in addition to the polysaccharides, such salts as naturally occur in the artichoke tuber, was treated in an electrodialytic apparatus fitted with such diaphragms that an excess of the cations in the salts escaped. As a result an appreciable amount of water was ionized, the OH^- ions also migrating to the anode to equalize the positive charges carried to the cathode, and the H^+ ion concentration of the extract was increased. At the same time a considerable percentage of the colloidal material in the extract was discharged and coagulated. Therefore the procedure accomplished both the acidification of the extract and the removal of much of the inorganic salts and the organic colliodal material in it.

A series of investigations was carried out in which the independent variables, viz. rate of flow of extract through the process, current density, concentration of solid material in the extracts, and the nature of the diaphragms, were varied and their effect on the dependent variables was noted, viz. $[H^+]$ produced in the extract, colloidal material coagulated, and cost of the process.

The results obtained may be summarized in a few generalizations:

(1) The final pH of the extract depends chiefly upon the per cent of cations or of total ash removed from it.

(2) Increasing either the rate of flow of the extract, or its concentration, or both, while other variables are held constant decreases the $[H^+]$ produced.

(3) Increasing the current density while other variables are held constant increases the $[H^+]$ obtained.

(4) The current density is directly proportional to the rate of flow of the solution if other variables are held constant.

(5) If the $[H^+]$ to be produced in the extract remains constant and the rate of flow of the extract is increased its concentration must be decreased or the current density increased, or both.

(6) About 40 per cent of colloidal material is coagulated during the production of an extract with pH of 4.2, that required for conversion of the polysaccharides under the conditions of our work.

(7) At 2 cents per kilowatt hour the cost of current to produce this pH is 0.04 to 0.1 cent per pound of finished syrup.

(8) With less permeable diaphragms in the apparatus the final pH is only slightly higher than with more permeable ones.

HOW IMPORTANT IS THE TIME FACTOR IN EXAMINATIONS?

BY

J. H. Sammis

Peoria Central High School, Peoria, Illinois

The importance of the time factor in the successful completion of examinations is bound to vary with the type of test used. We are concerned here with the short completion, multiple choice, or true-and-false test given as part of the daily assignment in any class in science. Lack of time has so frequently been offered as the reason for failure to satisfactorily handle a test that the author for a period of over two months gave fifty tests to his classes, which were given with one minute by stop watch for each question, and then repeated with an additional one minute allowance per question, any changes or additions being made in different colored pencil.

The results were uniformly consistent. Doubling the time for answering succeeded in raising the average grades in every test given by less than 5 per cent. In many cases individuals actually lowered the grade made with the original one-minute allowance. Instances of lowering grades were particularly in evidence among pupils ranking consistently in the lower quartel of their classes.

In view of the fact that the beauty of the short daily test lies in the small amount of time it takes, it hardly seems advisable to give too much time for answering questions on tests of the type discussed, notwithstanding pupil alibis to the contrary.

WHAT SHALL WE DO ABOUT THAT CHAPTER ON PHOTOGRAPHY?

BY

J. H. Sammis

Peoria Central High School, Peoria, Illinois

In view of the fact that nearly every text book on general inorganic chemistry contains more material than can be satisfactorily covered in the prescribed time, some of the material must be omitted. In deciding what material to use we feel that those subjects or phases of a subject should be taught which are (1) most commonly used or encountered, (2) most interesting and successfully mastered, and (3) most closely correlated to other subject matter in the curriculum.

If those statements be true, the chapter on photography has been unjustly dealt with in many instances. Examples of photography are daily making up larger and larger portions of our newspapers, magazines, and books, and one must not overlook the fact that motion pictures are photographs.

Photography is surely as interesting and as easily mastered as an understanding of Charle's and Boyle's laws. The relationships between photography and physics (lenses, light, filters, depth of focus, metric system), art (composition, distribution of masses, elimination or emphasis of detail), chemistry (development, compounding of formulae, reduction, intensification, common ion effect), journalism (news stories, year book snapshots) and teaching (lantern slides, copied pictures) is too apparent to need further attention.

The acquisition of entertaining, helpful, or at least harmless hobbies is something we as teachers are urged to encourage. Photography seems to meet the requirements of a fascinating and not too costly a hobby. We feel that the chapter on photography should be taught, and possibly where circumstances and enthusiasms permit, emphasized.

Papers In Economics

Extract from the Report of the Section Chairman

A symposium of four papers on "Problems of the Illinois Coal Industry," followed by a general discussion, comprised the program of the Economics Section.

The fourth article, "Competitive Position of Fuel Oil and Natural Gas with Coal in the St. Louis District," by C. V. Beck, President, Lumaghi Coal Company, St. Louis, is the only one not here represented.

No chairman was elected for the coming year.

(Signed) Walter H. Voskuil, *Chairman*

COMPETITION OF APPALACHIAN COALS, FUEL OIL, NATURAL GAS AND OTHER FUELS WITH ILLINOIS COAL IN THE ILLINOIS COAL MARKET AREA

BY

W. H. Voskuil

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ABSTRACT

Illinois supplies coal to seven states in the Upper Mississippi Valley. In this same area vast quantities of coal from West Virginia, Kentucky, and elsewhere, fuel oil from the crude petroleum supplies of the Mid-Continent field, and natural gas from Kansas and the Panhandle of Texas are also marketed. This Upper Mississippi Valley is a battle ground for competing fuels that originate in widely separated districts. Each fuel industry is equipped and prepared to supply a far greater quantity of fuel than the normal market of the area requires. Each fuel has been driven, by the keen competition for the market, into lower and lower price levels until a balance between costs of production and selling prices have been all but disregarded.

The boundaries of this territory, in which 90 per cent of the Illinois output is sold, have been determined by the competition of fuel oil and natural gas in the Southwest; the eastward movement of coal from Colorado, Wyoming and Montana into Kansas, Nebraska and the Dakotas; ex-lake coal in the shore counties of Minnesota and Wisconsin; and Indiana and Appalachian coals in the territory east of Illinois. Consumption of energy in the Illinois market territory in 1929—a year when the total Illinois output was 60,658,000 tons—is shown in the following table.

Summary of Energy Consumption in Illinois Market Area in 1929
(Gasoline Excluded)

	Quantity	Coal or Coal Equivalent, Tons
Bituminous coal, tons	102,858,155	102,858,155
Coke, tons	4,580,764	4,580,764
Briquets, tons	687,377	687,377
Anthracite, tons	2,705,946	2,705,946
Fuel oil, barrels	28,871,165	6,880,000
Natural gas, 1,000,000 cu. ft.	95,410,000	3,816,400
Water, power, 1,000,000 kw.-hr.	2,814,435	2,388,000

Low-cost transportation to lake territory offers a difficult problem for Illinois producers, but in the case of Appalachian coals, the preference engendered by the special qualities of some of these coals and the lower prevailing wages do not offer insuperable difficulties. The situation with respect to fuel oil may be expected to improve when the output of crude is controlled and the price raised sufficiently to make more cracking profitable. Markets in the states producing natural gas are becoming saturated, and future development means that outside outlets must be found, of which the Illinois market territory is the most important. Eventually these competitive interests must enter into closer cooperation to obtain for each a fair share of the market on the basis of scientific distribution.

ECONOMIC IMPORTANCE TO THE ILLINOIS COAL INDUSTRY OF THE MECHANICAL PREPARATION OF COAL

BY

D. R. MITCHELL* AND C. M. SMITH**

University of Illinois, Urbana, Illinois

ABSTRACT

Although the scientific preparation of coal is of fundamental economic importance to the coal industry of this State, it has been largely overlooked as a means of bettering the industry's status. However, an increasing demand on the part of consumers for cleaner and more closely sized coal is resulting in renewed interest in coal preparation.

The proportion of coal marketed in the larger and more profitable sizes has been declining for several years. In 1900, egg and lump coal constituted nearly 60 per cent of the State's output; whereas, in 1931 they made up only 40 per cent of it, the decline in the proportion of lump coal having been particularly severe. Correspondingly, the proportion of screenings rose from about 10 to 30 per cent.

Since screenings must frequently be sold at a loss the tremendous economic importance of their increased production is evident. One factor in the low price of screenings is that they normally carry a higher content of impurities than do the larger sizes of coal.

Although the mechanical cleaning of coal was once a major activity in Illinois, it declined almost to the vanishing point, following the World War. Within the past four years, however, there has been a pronounced increase in the amount of coal being cleaned mechanically. This is true in Indiana also, where more coal is being mechanically cleaned than in Illinois, although the Indiana production is less than one-half the Illinois production.

It is frequently asserted that Illinois has been losing its markets to eastern coals but analysis of coal shipments showed that, between January 1932 and January 1933, 80 per cent of the loss suffered by Illinois operators to competing producers was to Indiana and western Kentucky mines.

Coal from both of these districts is much like Illinois coal in composition, but the practice of mechanical cleaning has been growing rapidly in both states, and although price is probably the ruling factor, it seems clear that greater cleanliness and uniformity of product has aided these operators in invading Illinois' natural markets.

Contrary to the experience of the deep mines in Central and Southern Illinois, the output of some large strip mines in Northern Illinois has been increasing rapidly in recent years. In each case the product is either partly or wholly cleaned mechanically, and uniformity of output is assured by routine chemical analyses.

It is evident that the consumer satisfaction engendered by an acceptably clean coal of uniform ash and sulphur content has been a factor in enabling these mines to grow in the face of the depression. It is by fostering such consumer satisfaction that Illinois operators in general can hope to recapture their former markets. The scientific preparation of coal is a step in this direction.

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THE GROWTH OF COAL SHIPMENTS BY MOTOR TRUCK INTO ST. LOUIS AND ITS EFFECT ON THE TRANSPORTATION AND MINING INDUSTRIES

BY

FRANK T. TIBBE

Better Business Bureau, East St. Louis, Illinois

ABSTRACT

At the beginning of the practice of hauling coal from mines by truck, direct to consumers in St. Louis, the general trucking rate was $2.00 per ton. At this rate the railroads were not bothered or even concerned, as it made no inroads upon their tonnage, so to speak, but the individual trucker soon discovered that this rate would enable him not only a fair profit on the haul, but it also opened up an easy avenue for him to get into the coal business at a nominal cost regardless of the equipment he had; he advertised by telephone number, carried no stock on hand, securing his coal from nearby mines in Illinois and delivering direct to the consumer in quantities of from 1 to 8 tons at a very low figure, much less than the rail rate that dealers with yards and railroad switches must pay. Regular dealers must and do have to take care of public demands under any and all conditions while these individual truckers, sometimes called "Snow Birds", meet none of these obligations or requirements. They became so numerous that at the present time more than 1,200 are engaged in this particular line of transportation of coal into St. Louis.

While there is no means of accurately checking the total movement of coal at both sides of the Mississippi River, it is estimated that ⅓ of the total truck coal goes to points on the east side such as East St. Louis, Madison, Granite City, etc. Due to the fact that East side cities are closer to the mine a relatively larger amount per capita of truck coal goes to these communities. This estimate of ⅓ of the truck tonnage to East side communities and ⅔ to St. Louis, Mo., is arrived at after consultation with a number of large truck mines who agree, after an analysis of their records, that this division is approximately correct. It is therefore apparent that the total truck movement and consequent loss of rail tonnage is approximately as follows, during the period under observation in this analysis.

	Tonnage actually checked as coming across Free Bridge to St. Louis. Estimated as 2/3 of total movement.	1/3 estimated as going to East side communities.	Total estimated movement.
Feb. 9-10 (24 hours)	8,655	4,328	12,983
Feb. 10-11 (24 hours)	10,438	5,219	15,657
Feb. 11- (16 hours)	8,412	4,206	12,618
Feb. 12- (12 hours)	1,263	632	1,885
Feb. 13-14 (24 hours)	8,513	4,256	12,769
Feb. 14-15 (24 hours)	7,837	3,918	11,755
Total	45,118	22,559	67,677

From the above it is apparent that the total truck movement during this five day period was approximately 67,677 tons, which was lost to the railroad, and is the equivalent of 1504 forty-five ton cars.

The above gives a very accurate picture of how trucking is increasing to St. Louis, Missouri. The Free Bridge has been checked more or less periodically for the last eighteen months. Each check reveals a material increase over all preceding checks. The check made in November and December showed a peak movement of slightly over 6,000 tons a day. This check shows an increase over any preceding check of from a minimum of 30 per cent to a maximum of 70 per cent increase. It explodes completely the idea that trucks cannot successfully operate in bad weather. The first day of this check it was 3 below zero, one of the coldest days in recent years, and there was a large quantity of snow and ice on the roads.

The year 1930 is the last year in which accurate figures of the truck coal loadings, St. Clair and Madison County, Illinois, are available. During 1930 slightly over 900,000 tons were loaded into trucks. From the above figures, it will be seen that in a good week truck loadings now are running close to 90,000 tons a week total.

Papers In Geography

Extract from the Report of the Section Chairman

Of the eight papers that comprised the program of the Geography Section, only four are here represented. The others were:

"Reconnaissance Traverse in Ontario Peninsula," by Charles C. Colby, University of Chicago, Chicago, Illinois.

"Father Nile and Egyptian Agriculture," by W. O. Blanchard," University of Illinois, Urbana, Illinois.

"Distribution of Fisheries of the North Atlantic," by Vellora Foster, Northwestern University, Evanston, Illinois.

"The Water Factor in the Geography of East St. Louis," by Lewis F. Thomas, Washington University, St. Louis, Missouri.

Attendance at the meeting was nineteen.

Mr. Alfred W. Kasel, Moline High School, Moline, Illinois, was elected chairman of the Geography Section for 1933–34.

(Signed) Ruby M. Harris, *Chairman*

PROBLEMS OF LAND UTILIZATION IN ANTRIM COUNTY, MICHIGAN

BY

HERBERT N. COWLES

Northwestern University, Evanston, Illinois

ABSTRACT

Antrim County is situated on the east shore of Grand Traverse Bay, which is an arm of Lake Michigan located in the northwestern part of the lower peninsula of Michigan.

The topographic features of Antrim County, glacial in origin, may be classified into four physiographic provinces: (1) The lake benches and valley flats which border the inland lakes and extend into the interior valleys; (2) the rolling uplands, or rolling hills that occupy the high areas of the western townships; (3) the hilly uplands, which are the high recessional moraines of the central townships; and (4) the high plains, which are the barren outwash plains of the southeastern townships.

Antrim County was originally covered with excellent stands of hardwood forest along with a little white pine. The western part of the county has been cleared for about eighty years and is now farmland of relatively good quality.

The central and eastern parts of the county have been cleared of virgin timber and are now covered with a dense second growth of hardwood. These sections are poorly suited for agriculture but the second growth should be of value when mature.

The manufacturing industry has practically ceased to exist with the decline of the lumber industry. One large lumber, iron, and chemical plant is now in operation.

Recreation has become of major importance in Antrim County, where a splendid chain of lakes, numerous streams, large forested areas, a favorable summer climate, and ready access give this area unusual advantages. While resort development is fairly extensive along some of the lakes, no lake has approached its potential development. Hunting is apparently the one use for which the wastelands of the southeastern townships are suitable. The value of these lands for recreation will be increased when they are better stocked with game, and when the fire hazard is reduced.

Much of the area of Antrim County which formerly was utilized for lumbering or other industrial purposes is now utilized for recreation. The loss of population following the exhaustion of the forest resources is made up in part by the annual influx of tourists and resorters during the summer. Farms which once supplied forest and industrial workers with food products, now supply summer visitors with fresh garden, orchard, dairy, and poultry products, thus supplementing the income from crops. Taxes paid by owners of summer homes make up in part for the taxes once paid by industry. The problem of land utilization, arising from the loss of the most important resource of the county, the forests, may be met, in part, by the development of the recreational resources along with specialization of agriculture to meet the particular demands.

THE APPLE INDUSTRY OF CALHOUN COUNTY

BY

ALFRED W. KASEL

Moline High School, Moline, Illinois

Calhoun County, located in western Illinois, has achieved an outstanding position among the counties of the state in the production of apples. The county at present (1933) produces approximately a third of the commercial apple crop of the state. The average annual commercial apple crop in the county for the past eleven years has been approximately 422,000 barrels. In 1930 it exceeded 600,000 barrels.[1]

Significant changes in the marketing of Calhoun County's immense crop of apples have come about within the past decade. Chief among these changes are the improvement of facilities for transporting the apples to market, the rise of Chicago as a major market comparable with St. Louis, the advent of the itinerant trucker, and the improvement of facilities for the wholesaling of apples by commission firms in St. Louis.

Nearly all of the county's apples prior to 1925 were carried to the St. Louis market or to railway loading points by river craft. Since 1931 none have been carried by this method. Improvement of railway facilities and highways, the construction of a vehicle bridge across the Illinois River at Hardin in 1931, and the increased use of the motor truck have been the major adjustments which eliminated river craft as a means for transporting the apples.

The need for better facilities than river craft afforded became acute with the ever increasing volume of apples shipped from the county after 1910 and also by a demand on the part of apple buyers for a better quality of produce. The improvement of rail facilities in 1924 accomplished by the extension of a branch of the Alton Railroad from Titus to East Hardin ushered in a new era for the apple shippers of Calhoun County. The building of this railroad was the principal factor in making Chicago a major market for Calhoun County apples comparable with St. Louis.

The motor truck has become a major means of transporting the apple crop to the market centers within the past several years, mainly because of the improvement of Illinois highways. The use of the motor truck is a distinct advantage to the industry.

In the summer of 1932 the facilities for the wholesaling of apples by St. Louis commission firms were greatly improved through the establishment of the St. Louis Apple Exchange. The exchange was organized for the purpose of combining the receipts of apples in one central location in order to serve the interests of the grower, shipper, and buyer.

Although the previously described changes have meant an improvement in the former inefficient methods of marketing the apples, there are a number of problems remaining to be solved before Calhoun County can be said to have a really efficient system of marketing. The problems are concerned with an expected large increase in production within the next decade, standardization of pack, successful advertising, development of the by-product industry, improvement of roads within the county, and the development of a successful cooperative marketing organization to help solve the problems connected with the before mentioned factors.

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[1] Data from Illinois State Department of Agriculture.

THE LAND UTILIZATION OF TOWANDA TOWNSHIP McLEAN COUNTY, ILLINOIS

BY

MARGARET MEANS

Bloomington, Illinois

Towanda Township is located in the central part of McLean County, Illinois. It is a congressional township, six miles square. The first settlers came between 1840 and 1850. The early occupations were typical of other agricultural communities of the open prairies. The first settlements were made in the groves where fuel, water, shade and shelter were found.

Cattle raising was introduced in the first decade of settlement. After the Civil War a more scientific agriculture was introduced, including a rotation of crops, especially corn, oats and wheat, and livestock production, including hogs, cattle and sheep.

The topography of Towanda Township is that of a gently rolling prairie with very little variation of relief, brought about mainly by the formation of glacial moraines and stream erosion. The main drainage system is that of Money Creek.

Soils are largely loessial in character. The upland prairie soils comprise about 95 per cent of the area. They are rich in organic matter and were covered originally with wild prairie grasses.

The native vegetation consists of forest and grasslands. The forests covered but a small portion of the total area and were found mainly along the stream valleys. Much of the prairie land was wet and marshy with coarse high grass. On the uplands the grass was short and wiry.

The climate is continental in character with cold winters and warm summers. The growing season is approximately 173 days. The precipitation averages 37.41 inches per year, well distributed for the growing of crops.

The early settlers of Towanda Township came from Indiana, Ohio, Virginia and Kentucky. Settlements were first made along the streams and then on the open prairie. The population is almost entirely native-born and has been chiefly rural since the first settlement to the present time.

Two railroads cross the township and excellent concrete highways cross various parts of the area.

The city of Bloomington furnishes a good local market for agricultural and dairy products while Chicago is the chief grain and hog market.

At the present time corn occupies 50 to 60 per cent of the cultivated area with oats, hay, barley, soybeans and wheat occupying the remaining acreage.

There were 126 farms in Towanda Township in 1928 with an average size of 184 acres. At the present time there is no woodland whatever in the township; 81.4 per cent is in crops, and 18.6 per cent is in pasture.

Farm facilities such as tractors, telephones, automobiles, furnaces, radios and running water, are common throughout the township. The farm homes are well built and well kept. The rural schools are better than the average.

The animal distribution shows that hogs are becoming important, that cattle feeding is not profitable, that sheep show a notable increase, that the work usually done by horses and mules is being carried on by machinery, and that poultry raising is important.

A large percentage of the land is still held by descendants of the original owners. The farmsteads are attractive and well equipped.

Towanda Township is a typical well developed region of the Corn Belt and it represents a well-to-do community in the open country.

A CHILEAN VINEYARD

BY

ROBERT S. PLATT

University of Chicago, Chicago, Illinois

ABSTRACT

The Viña Conchalí is in the heart of Chile in the Central Valley. The district is semiarid and development depends largely on water for irrigation provided by streams from the high Andes. A share of the water diverted from the Rio Mapocho above Santiago and carried in a canal along the valley side is delivered to the Viña Conchalí at the upper edge of the property and thence distributed in a carefully laid out system of ditches reaching every field.

The size of the property is 275 acres, of which 100 acres are in steep slopes of the mountain foot and 175 acres are in the valley plain.

In this setting the owners have developed a high grade wine vineyard. The valley land of alluvial silt, deep and fertile, well drained and well watered, is divided by ditches and roads into 40 fields, practically all occupied by vines. The slope land is unimportant, being given over mainly to untilled pasture. In addition there are small patches of subsistence crops distributed along the base of the slope and along the main road near laborer's dwellings.

There are 26 small houses in which live the fixed inhabitants of the estate, Chileans of mixed white and Indian blood. The Chilean proprietors of the vineyard do not live on the property. The principal house is occupied by the manager, a Frenchman skilled in wine production.

The wine making establishment is at the main transportation focus of the estate, a location reflecting the need for immediate treatment of the perishable crop and also the incentive to nearby reduction of the bulky fruit to a more compact product. After a period of seasoning in storage vats the product is transported by truck to a warehouse in Santiago whence it is distributed to the Chilean market. The functioning of the whole establishment moves in the annual cycle of grapes and wine.

The Viña Conchalí is typical of one sort of development in central Chile. In addition there are grain farms, livestock farms and fruit orchards. These all are in contrast with rural establishments in other parts of Chile—unirrigated farms of the forest region a little farther south and subtropical oases few and far between in the desert regions to the north.

PAPERS IN GEOLOGY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

All of the papers given before the meeting of the Geology Section are here represented.

Average attendance at the meeting was forty-five, maximum was fifty-five.

Mr. Charles H. Behre, Northwestern University, Evanston, Illinois, was elected chairman for 1933–34.

(Signed) J. E. LAMAR, *Chairman*

SOME PENNSYLVANIAN LIMESTONES OF THE CARLINVILLE QUADRANGLE, ILLINOIS *

BY

JOHN R. BALL

Northwestern University, Evanston, Illinois

ABSTRACT

The Carlinville quadrangle is in the southwest part of Illinois about 40 miles north of East St. Louis. The rocks of Pennsylvania age underlying the surficial deposits are chiefly shales and clays which disintegrate readily. Associated with them, however, are several limestones resistant enough to make ledges across the stream channels, and to make rock terraces in some of the valleys.

The limestones and their associated rocks belong to the McLeansboro series of the Pennsylvanian system. The aggregate thickness of the exposed part of the McLeansboro series is slightly over 100 feet. At least seven limestones of this sequence may be recognized quite readily. A few other instances of limestone outcrop, somewhat isolated, are known, and may prove to be different occurrences from those now recognized. The names of a few of the more important limestones follow, beginning with the oldest rock of the list: Shoal Creek limestone, Centralia limestone, Macoupin and Upper Macoupin limestones, and the LaSalle limestone.

Of this list the Shoal Creek limestone probably possesses the greatest amount of historical interest. On account of its frequent exposures in the vicinity of the city of Carlinville it has been called the "Carlinville" limestone. In all probability it has been confused with other limestones, both in the Carlinville quadrangle, and in other parts of the State. It is quite readily distinguished from other limestones of the quadrangle by its common occurrence in two prominent ledges, the upper one thicker and more massive and separated from the lower ledge by about 8 inches of dark shale. With the exception of the LaSalle limestone it is one of the thickest limestones in the quadrangle, and, with its lower member, attains an aggregate thickness of from 6 to 8 feet. In the vicinity of Carlinville it generally underlies other rocks of the McLeansboro series, but near Palmyra, in the northwest part of the quadrangle, it generally occurs as the uppermost of the Pennsylvanian rocks. This is due to the gradual inclination of all the Pennsylvanian rocks, the dip following a general southeast direction.

The Centralia limestone, lying in a stratigraphic position about 17 feet above the Shoal Creek limestone, and the Macoupin limestone, at about the same interval above the Centralia, are both quite distinct lithologically from the Shoal Creek. These two limestones resemble each other very closely, however. In some of the earlier geologic literature describing the rocks of this part of the State, occur references that imply some confusion in identity between the Centralia and Shoal Creek limestones, also. The Centralia limestone is one of the more fossiliferous rocks of the quadrangle and contains numerous brachiopods of common Pennsylvanian types. In color, texture, and in its habit of weathering, the Macoupin limestone resembles the Centralia quite closely. It may be distinguished, however, by its abundant fauna.

The LaSalle limestone is a prominent limestone. In the southeast part of the quadrangle, due to the structural attitude mentioned above, it becomes the capping rock of the McLeansboro series as far as represented in the outcrops. It is thicker, locally, than the Shoal Creek limestone, and is responsible for faintly developed rock terraces east of Carlinville.

* Published with the permission of the Chief, Illinois State Geological Survey.

THE MICROGRAPHY OF THE LEAD AND ZINC ORES OF THE UPPER MISSISSIPPI VALLEY

BY

A. F. BANFIELD

Northwestern University, Evanston, Illinois

ABSTRACT

Study of the Upper Mississippi Valley lead and zinc ores by means of the reflecting polarizing microscope leads to the following conclusions regarding their paragenesis.

The ore minerals—barite, calcite, galena, marcasite, pyrite and sphalerite —indicate deposition under low pressures and at temperatures less than the boiling point of water. No diagnostic minerals occur which prove or disprove any of the known theories of origin, but the association of marcasite and pyrite indicates that the ore solutions varied from acid to alkaline or neutral, for pyrite is generally deposited from alkaline or neutral solutions at all temperatures while marcasite is deposited from acid solutions and at low temperatures. Paragenesis of the ore minerals is as follows: (1) Pyrite was deposited first, in considerable abundance and over a long period of time. While marcastie has been considered the common iron sulphide in the past, pyrite being thought quite rare, the author's studies show that pyrite is almost as abundant as marcasite, solution and dolomitization of the Galena dolomite, which preceded ore deposition, made the country rock porous and enabled ore solutions to percolate through it and deposit pyrite, mainly by replacement, as small isolated crystals. The amount of pyrite so disseminated decreases gradually away from the fractures along which ore solutions traveled. At the point of pyrite deposition the ore solutions must have been alkaline or neutral although they may originally have been acid, the acidity being reduced by their reaction with the calcareous country rock. (2) Marcasite was deposited next as a thin band lining fractures. Its contact with pyrite forms a sharp line of demarkation while its upper surface consists almost entirely of crystal faces. The change from pyrite deposition to marcasite deposition was caused either by increased acidity of the ore solutions, or by their reaction with the wall rock being prevented by the coating of pyrite. (3) Sphalerite was deposited on the well defined crystal terminations of marcasite. Near the end of its deposition sphalerite was accompanied by galena, calcite, and soft, greenish botryoidal masses of pyrite and marcasite. (4) Galena was deposited with and after sphalerite, erratically in the flats and pitches and abundantly in the crevices. (5) Calcite commonly occupies the center of flats and pitches and hence is younger than the above minerals. It occurs in two forms—an older rhombohedral and a younger scalenohedral. (6) Barite is rare but where seen is apparently the last mineral deposited.

Summary. The ore minerals of the Upper Mississippi Valley lead and zinc deposits were laid down in the following order: (1) pyrite disseminated in country rock; (2) pyrite along fractures; (3) marcasite along fractures and to a much lesser extent disseminated in the country rock; (4) sphalerite alone; (5) sphalerite with soft greenish botryoidal iron sulphides, galena and calcite; (6) galena; (7) calcite in rare early rhombohedral forms and abundant later scalenohedral forms; (8) barite. The relation between stages 5, 6, and 7 is gradational.

THE ORIGIN AND ECONOMIC IMPORTANCE OF BEDDING PLANE MOVEMENTS

BY

CHARLES H. BEHRE, JR.

Northwestern University, Evanston, Illinois

The term "fault" is restricted in practice to such movements only as take place in planes at sufficient angle to the bedding to produce noteworthy offsets. On account of their difficulty of recognition, movements parallel to the bedding or nearly so are largely neglected, yet they are mechanically necessary under many structural conditions.

In the case of parallel folds, gliding on bedding planes necessarily results if the folding is at all measurable. The famous Bendigo saddle reefs are clearly related to such movements. In folding produced by lateral compression bedding plane movements pass upward along the limbs of the folds until they come near the anticlinal crest, where load and support from below are lessened; here on the crests they tend to pass into recognizable reverse faults—the obvious results of thrusting. Such larger movements are frequently accompanied by smaller fractures which allow internal adjustments within the hanging- and foot-walls. Such fractures are reported from numerous mining districts.

Most larger thrust faults are either nearly horizontal, in which case they are commonly almost parallel to the bedding planes, as in the Wisconsin-Illinois lead-zinc district (where the movements are small), or the fault plane curves so that the angle of dip varies as the surface is approached. It is shown diagrammatically that such a curvature tends to result in openings of considerable width along the major fault plane. These openings afford means for the ingress of solutions; hence in part the common occurrence of mineralization in lens-like masses along the dip of the plane, forming at least some of the familiar "ore shoots" of such districts as Grass Valley, California, and Leadville, Colorado. Moreover small faults whose planes intersect the major thrust at sharp angles represent a mode of adjustment by the underlying and overlying rock masses, permitting the partial "chinking-in" of lenticular openings like those mentioned. Minor faults of this origin also afford means of ingress for mineralizing solutions.

Finally, where the major fault plane is curved, as mentioned above, and intersects the bedding at a steep angle, the strata cut by the fault are put under varying horizontal stress by the shift in the bulge on the opposite rock wall. Under such conditions those beds which project farther into the fault plane than others tend to be pressed back, away from the fault. Thus again movement along bedding planes is set up.

Several faults which have been carefully studied in ground plan or vertical section or both are cited as illustrations, the examples selected being partly from the published literature, partly from the writer's experience. Their bearing on mineralization and mining problems is discussed and the conclusion is drawn that many ore deposits are definitely related to faults of the types mentioned in which the movement is essentially along bedding planes.

CLEATING IN COAL

BY

E. C. Dapples

Northwestern University, Evanston, Illinois

Cleating in bituminous coal has been observed for many years in districts where it has a marked influence upon the mining of coal although in other states such as Illinois it has been passed by unnoticed. Although most pronounced in bituminous coals, it does not seem to be a criterion of rank since it may be observed in all coals ranging from lignite through bituminous; anthracite however exhibits columnar structure. Reger and Behre in West Virginia and Pennsylvania came to the conclusion that the average strike direction of the principal cleating paralleled the local structure which in turn paralleled the principal ranges of the Appalachians.

In order to determine the persistence of the strike direction of cleating in Illinois coals, numerous readings were taken at various points. In Perry county, three miles south of Pinckneyville, the cleating in the No. 6 coal fell into two systems, N. 7°–37° W. and N. 52°–55° E. The limestone overlying the coal showed jointing in two series as follows, N. 16°–39° W. and N. 55°–65° E. At Pyatts the same coal possessed three cleat systems, (1) N. 45°–59° E., (2) N. 5°–35° W., and (3) N. 84°–85° E. Ten miles southeast at Hallidayboro, the coal showed three systems of cleats, one direction being less prominent than the others. These are listed as follows:

N. 35°–70° W.; N. 10°–19° W.; and N. 30°–40° E. (least prominent). Here as at Pinckneyville the overlying limestone was jointed in two directions, N. 53°–73° E. and N. 7°–23° W. Two miles north of Marion the same coal showed well developed cleat in a direction of N. 30°–40° W. and a poorly marked one N. 15°–38° E. Along the LaSalle anticline, at Lowell, strike directions of cleats were N. 46°–48° E. and N. 33°–55° W., while jointing in the non-carbonaceous material was exceedingly prominent in the following two systems, N. 35°–47° W. and N. 46°–55° E.

At all points of observation jointing in the non-carbonaceous strata paralleled cleating, and the prominent direction of jointing was always the strike of the pronounced cleat. It was further apparent that cleating was more pronounced along the axes of anticlines and became less marked away from the folds. Such observations are in direct accord with the conclusions of Behre and Reger for the Appalachian district. It is believed therefore, that jointing in sedimentary strata and cleating in coal are closely related, being formed contemporaneously by the same tectonic stresses rather than the result of processes of drying or coalification.

SUBSURFACE GEOLOGY IN THE EAST ST. LOUIS REGION *

BY

GEORGE E. EKBLAW AND L. E. WORKMAN

Illinois State Geological Survey, Urbana, Illinois

A study of available sets of sample cuttings from many of the deep wells in the vicinity of East St. Louis reveals some interesting problems.

The strata dip generally northerly and easterly, successively higher formations are encountered at the surface, and each outcropping formation increases in thickness away from the Ozark anticline. Pennsylvanian strata thicken rapidly in Illinois but occur only locally in Missouri. There is a marked unconformity at the base of the Pennsylvanian system. Chester strata, absent in Missouri but almost everywhere present in Illinois, thicken rapidly from west to east and from northwest to southeast, overlying the Ste. Genevieve formation unconformably. The St. Louis formation has a fairly uniform thickness, ranging from 250 to 300 feet. In Missouri it is thinner owing to surficial erosion but in Illinois it has its full thickness and is overlain conformably by the Ste. Genevieve formation whose thickness varies according to its location relative to the regional structure. It appears that to the west the St. Louis formation overlaps the older Salem and Warsaw formations, but the data are too scanty to assure the relations.

The Salem and Warsaw formations are fairly uniform but are slightly thinner to the north and east. The Keokuk-Burlington formations are also fairly uniform although they are appreciably thicker north and west than east of Mississippi River and south of East St. Louis. The Fern Glen formation is of uniform thickness in the East St. Louis region. It thins out and disappears to the west and is also lacking a short distance north and west of Alton, due probably to non-deposition. The Kinderhook series is thin everywhere and is sometimes absent in the East St. Louis region but it thickens appreciably to the north.

The combined Devonian and Silurian systems are absent in the west and their thickening to 500 feet in the east is a noteworthy feature. Most of this thickening is in the Silurian system which consists of a lower gray limestone, a middle "red rock", and an upper gray shaly limestone. These formations successively appear from west to east, showing that there is an important angular unconformity between the Devonian and Silurian systems. The Devonian system thickens from a few feet in the west to as much as fifty feet in the east. The Maquoketa formation is fairly uniform in thickness although it has some regular variations. It thins to the west, probably as a result of the same erosion that terminated the Silurian formations. The Kimmswick, Decorah, Plattin, and Joachim formations may be considered as a single unit that thickens slightly to the east. The St. Peter formation is fairly uniform in thickness although irregularities would not be unexpected. The Prairie du Chien series, consisting of the Powell, Cotter, and Jefferson City formations, and the Roubidoux formation are encountered in several wells but show no marked variations. Formations below the Roubidoux have been encountered in but few wells.

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STUDY OF THE INTERVAL BETWEEN COAL NO. 6 AND THE SHOAL CREEK LIMESTONE *

BY

M. W. FULLER

Illinois State Geological Survey, Urbana, Illinois

Stratigraphic studies of Pennsylvanian cyclothems in Illinois have shown that thicknesses of the individual cythothems vary considerably in different parts of the basin. This variation has resulted from two factors, (1) proximity to source area of sediments, and (2) differential warping during Pennsylvanian time, generally along preëxisting axes.

In general, cyclothems increase in thickness toward the southeast. This is particularly true of the sandstone and sandy shale members. Coals increase in number because of the wedging in of many new cyclothems toward the source area. Underclays and marine beds, however, generally increase in thickness toward the north and west.

In studying the general thickening of Pennsylvanian sediments to the southeast, two persistent, easily recognizable beds, coal No. 6 and the Shoal Creek limestone, were chosen and the interval between them was determined at as many points as possible. From these data an isopachous contour map was prepared. This shows a decrease in interval over known anticlinal structures and an increase in interval over known synclinal structures.

This interval has a minimum thickness of 83 feet in northwest Macoupin County on the flank of a nose of the old Ozark dome which during Pennsylvanian time was much more stable than the progressively subsiding basin. Here six cycles are represented between coal No. 6 and the Shoal Creek limestone. Several lack their sandstone, coal, and shale members. The interval is greatest in east central White County in the deepest part of the basin where 708 feet of strata are present between the datum planes and about 14 cyclothems are represented.

The most important structure in Illinois that affected Pennsylvanian sedimentation was the DuQuoin anticline. This structure was initiated at the close of Mississippian time and differential warping continued throughout the Pennsylvanian period. The interval between coal No. 6 and the Shoal Creek limestone increases markedly east of the anticline as the result of the wedging in of many new cyclothems and the thickening of clastic members of the persistent ones. The effect of the LaSalle anticline on Pennsylvanian sedimentation is less well known but was probably similar, as several sandstones wedge out on the flanks of the structure, making traps for oil and gas.

In northeast Madison County and adjacent parts of Montgomery and Bond counties there is a decrease in interval which marks the crests of the New Douglass dome and Panama anticline. In the southwest part of Marion County and adjacent parts of Clinton and Washington counties there is a decrease in interval which seems to be closely related to the structures from which oil and gas are obtained.

Because this isopachous map shows a decreased interval over known anticlinal areas, it is possible that this method of mapping will reveal previously unknown structures which might yield oil or gas.

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OUR PRESENT KNOWLEDGE OF AMERICAN COAL BALL PLANTS

BY

A. C. NoÉ

University of Chicago and Illinois State Geological Survey

The investigation during the past year centered about the coal balls collected in the old strip mine at Calhoun, Richland County, which has yielded much excellent material.

During previous years it was primarily the material from Harrisburg and Danville which was examined and of which preparations and microphotographs were made. As a rule, coal balls from only one locality are examined at a time in the paleobotanical laboratory of the University of Chicago where the coal ball studies for the Illinois State Geological Survey are carried out.

About 240 Calhoun coal balls were cut of which a number were sectioned and studied in detail. A research student, Mr. Roy Graham, used some of this material for the preparation of a dissertation on which he is to receive his doctor's degree at the 1933 June Convocation of the University of Chicago.

Of particular interest is the fact that the Calhoun coal is one of the youngest in the State, being of McLeansboro age. Worthen classified it as No. 13 or 14, the Harrisburg coal as No. 5, and the Danville coal as No. 7. The impending reclassification of Illinois coals according to cyclothems will undoubtedly give other numbers but their relative positions will not be materially changed.

The fossil plants found in Calhoun coal include a number of species of Calamites, Sphenophyllum, Lepidophloios, Lepidodendron, various ferns, such as Anachoropteris, Botryopteris, Corynepteris, Scolecopteris, Ptychocarpus, Cyathotrachus, Psaronius, a new fern genus, Sphaerotheca, a number of Cydofilicales such as Heterangium, Telangium, Conostoma, as well as a Gymnosperm, Cordaites.

The time-saving cellulose peel method has been used almost exclusively in preference to cutting individual coal ball sections and grinding them down to microscopic thinness. After the coal ball is cut in two or more portions and has been found to contain valuable information, its cut surface is smoothed. Afterward this surface is etched with diluted hydrochloric acid which removes a thin layer of the limestone matrix but leaves all organic enclosures intact. A solution of cellulose acetate in acetone or of parlodion in equal parts of absolute alcohol and ether is poured on and left to dry until a solid film forms. This film, which is easily removed, contains the organic particles in exactly the same position which they held while imbedded in limestone. In other words, we have a very thin section where calcium has been replaced by cellulose. This method has been improved by Mr. Graham, who used nitro-cellulose dissolved in butyl acetate (see "Stain Technology," April, 1933 for more complete report). In microphotographs prepared from such cellulose peels, the minute spores show extremely well, even at a magnification of 1,000 diameters.

The floras of all Illinois coal balls so far investigated can be correlated with the fossil plants of the Stephanian group of the Upper Carboniferous period in England and the continent.

THE CHERT OF THE NIAGARA SERIES OF THE CHICAGO AREA

BY

JOHN R. SCHULTZ

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The chert of the Niagara series in the Chicago area shows the following field relationships, which are believed to be diagnostic:

(1) Many of the chert bands branch laterally into two.

(2) Many nodules show finger-like projections which penetrate the wall rock at right angles to the bedding.

(3) Several steeply inclined layers or "feeders" of chert, which connect above and below with nearly horizontal bands, were observed in the Joliet quarry.

Other important features, but of less diagnostic value, are (a) silicified fossils in the chert and wall rock, (b) irregular inclusions of wall rock in the centers of many nodules, (c) silicification along joints and bedding planes, (d) distribution of the chert along bedding planes and along the tops of shale intercalations, and (e) arching of shale stratification around chert nodules.

It is thought that the chert has originated through segregation of siliceous material from out of the Devonian shales which formerly covered the area, and in part from the finely divided siliceous matter originally present in the Niagaran series itself. The agent effecting the segregation was, in all probability, circulating ground water. Colloform structures in the chert indicate that the silica was carried in solution as a colloid, and was precipitated by reaction with the carbonate wall rock.

Microscopic evidence indicates that the silica was originally precipitated as a gel, which later crystallized into various forms of hydrated, crystalline silica, later recrystallization of which converted a part of the mass into quartz.

The chert replaced, and to a smaller extent displaced, the surrounding wall rock. Cavity filling seems to have been relatively unimportant.

PENNSYLVANIAN ROCKS OF MADISON AND ST. CLAIR COUNTIES, ILLINOIS

BY

H. R. Wanless

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Madison and St. Clair counties lie on the western edge of the Eastern Interior coal field. The contact of the Pennsylvanian and Mississippian systems crosses western St. Clair County and western Madison County, touching the Mississippi bluffs near Alton. It lies concealed beneath recent alluvial sediments in the American bottoms. A large outlier of the Eastern Interior coal field occurs in the eastern part of St. Louis County, Missouri. The succession of Pennsylvanian strata exposed in these counties ranges through the Pottsville, Carbondale, and lower McLeansboro formations or from the Babylon to Macoupin cyclothems of the classification introduced by the writer and J. M. Weller. The succession of strata in this district are abnormally thin, due to the influence of a weakly positive area along the eastern flank of the Ozarks which, during most of the Pennsylvanian period, stood above the profile of equilibrium and did not receive as thick accumulations of sediment as the trough to the east. The St. Louis area lay rather on the southwest edge of this Ozark flank, and its effect on sedimentation is even more pronounced northward, in Jersey, Greene, Pike, Calhoun, Brown and Adams counties. Southward from the St. Louis region, and even in the eastern parts of Madison and St. Clair counties, the section of strata thickens notably, and in southeastern Illinois the zone represented in these counties by less than 500 feet of sediments is represented by over 2000 feet. Shales, sandstones and coals are the strata which have thinned most notably in this area, and limestones and more or less refractory clays make a much larger portion of the section than elsewhere.

THE WARSAW FORMATION [1]

BY

J. Marvin Weller

Illinois State Geological Survey, Urbana, Illinois

Since Hall proposed the name Warsaw in 1857[2] for strata between the Keokuk and St. Louis limestones, the limits of this formation have been revised several times.[3] In 1908, Stuart Weller[4] correlated the upper eight feet of this formation at its type locality with the Salem limestone of Indiana and since that time it has been customary to recognize both the Warsaw and Salem formations in the Mississippi Valley. Because the Warsaw formation as thus restricted was considered equivalent to the Harrodsburg limestone of Indiana, the latter name has been abandoned.[5]

Practically all of the common Warsaw and Harrodsburg fossils are present in the Salem limestone of Indiana but in the Salem there also occurs a variety of small molluscs associated with innumerable shells of *Endothyra baileyi.* This is known as the Salem or Spergen Hill fauna and on its basis the Salem limestone was recognized in the Mississippi Valley. It is now known that this fauna is of no value for precise correlation but records a peculiar environment that existed at different times in different areas. It first appears in the Short Creek oölite at the base of the Warsaw formation in southwestern Missouri, and recurs in the Salem limestone of Indiana, in the so-called Salem of Ste. Genevieve County, Missouri (probably in part of lower St. Louis age), and in the Ste. Genevieve limestone at various places. Very similar forms occur in Chester and Pennsylvanian strata.

From Alton, Illinois, northward, beds referred to the Salem do not resemble the typical Salem limestone lithologically or faunally. Except for a small area in and adjoining southeastern Iowa where the so-called Salem is separated by an unconformity from the underlying Warsaw (restricted), there is no more basis for their differentiation than there would be for the recognition of the upper and lower divisions of the Warsaw (restricted) as distinct formations. It is doubtful that the so-called Salem-Warsaw (restricted) boundary in the Mississippi Valley is drawn at exactly the same horizon as the Salem-Harrodsburg boundary in Indiana or that the lithologic change at which the former is drawn occurs at even an approximately uniform horizon between Hancock and Monroe counties, Illinois. Because of these and other uncertainties it seems unfortunate that the Warsaw formation should have been restricted, thus causing the abandonment of such a well established name as Harrodsburg, particularly as it is impracticable to attempt any subdivision of these beds in some areas where a single name for this entire interval would be convenient.

It is proposed, therefore, to restore the Warsaw formation to its early status, assigning to it all beds between the Keokuk and St. Louis limestones as these are now limited. Where desirable the Warsaw formation may be subdivided into more or less local members.

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[1] Published with the permission of the Chief, Illinois State Geological Survey.

[2] Hall, James, Observations upon the Carboniferous limestone of the Mississippi Valley: Amer. Jour. Sci., ser. 2, Vol. 23, p. 193, 1857.

[3] Hall, James, Report on the Geological Survey of Iowa, Vol. 1, p. 97, 1858.
Weller, Stuart, The Salem limestone; Ill. Geol. Survey Bull. 8, p. 163, 1908.
Butts, Charles, Geology and mineral resources of Jefferson County, Kentucky: Kentucky Geol. Survey, ser. 4, Vol. 3, pt. 2, p. 157, 1915.
Van Tuyl, F. M., The stratigraphy of the Mississippian formations of Iowa: Iowa Geol. Survey Vol. 30, p. 185, 1925.

[4] Weller, Stuart, *Op. cit.*

[5] Butts, Charles, *Op. cit.;* Cummings, E. R., The nomenclature and description of the geological formations of Indiana: Indiana Dept. Cons., Pub. 21, p. 493, 1922.

THE STRATIGRAPHIC POSITION OF THE HOING SAND *

BY

L. E. Workman

Illinois State Geological Survey, Urbana, Illinois

The "Hoing sand" is a stratum of sandstone and sandy dolomite, that bears oil and gas in the Colmar-Plymouth Field of southwestern McDonough County in western Illinois. It was encountered at a depth of 417 feet in an oil test well on the J. Hoing farm and from this farm it received its name.

The "sand" varies from a porous, white to brown, quartz sand to a more or less porous, brown, sandy dolomite. The sand grains are of fine to medium size, apparently having been well rounded and frosted at the time of their deposition but now more or less coated with secondary crystalline quartz. The dolomitic sandstone and sandy dolomite have a matrix of brown dolomite crystals the size of silt. Scattered fragments of brown resinous *Sporangites huronense* are found in both the sandstone and sandy dolomite. The Hoing sand lies on a dark brown, highly bituminous shale of the Maquoketa formation and is overlain by brownish gray, coarsely granular to lithographic limestone in which sand grains of the Hoing sand type are common.

The Hoing sand was originally interpreted by Savage and Blatchley[1] as being of Devonian "Hamilton (?)" age, and the statement was made that the oil occurs "in a sandy limestone that is doubtfully identified with the lower part of the Devonian or the upper part of the Silurian systems." In later studies, after considerable drilling had been done in the field, Morse and Kay[2] definitely assigned the Hoing sand to the base of the Niagaran series. It was interpreted as "sand that was washed into the valleys and low areas when the Maquoketa shale was land surface and exposed to erosion," and that it was "reworked by the Niagaran sea."

Studies of numerous sets of sample well cuttings from Western Illinois bring out the following points regarding the stratigraphic relationships of the Hoing sand: (1) The unconformity at the base of the Silurian does not extend through the Maquoketa shale in this region and the Maquoketa does not have any sand grains of the Hoing sand type which might be left as a residual product of erosion to be concentrated by Silurian seas as the Hoing sand; (2) sand grains of this type are not found in the undoubted Silurian beds anywhere in this region; (3) there are no typical Silurian beds above the Hoing sand in the Colmar-Plymouth field; (4) sand grains of the Hoing sand type are characteristic of basal Devonian strata in this region and elsewhere in Illinois; (5) the Hoing sand in the Colmar-Plymouth field grades upward from porous sandstone into dolomitic sandstone and finally into sandy, dolomitic limestone of undoubted Devonian age; (6) the Hoing sand and the limestone beds above it contain *Sporangites huronense* common in Devonian strata; (7) the Hoing sand horizon is encountered in wells westward from the Colmar-Plymouth field where the Devonian unconformity successively overlaps Maquoketa and Kimmswick formations of Ordovician age.

It is therefore concluded that the Hoing sand is Devonian in age.

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* Published by permission of the Chief, State Geological Survey, Urbana, Illinois.

[1] Blatchley, R. S., "Plymouth Oil Field," Illinois State Geol. Survey Bull. 23, pp. 51-53, 1917 (Extract published 1914).

[2] Morse, W. C., and Kay, F. H., "The Area South of the Colmar Oil Field" and "The Colmar Oil Field—A Restudy," Ill. State Geol. Survey, Bull. 31, pp. 8-55, 1915.

Papers In Physics

Extract From the Report of the Section Chairman

The Physics Section held a joint session with the Chemistry Section for the first five papers (see Papers in Chemistry) after which the two groups separated. Six papers were given before the Physics Section, only four of which are here represented. Those not included are:

"Photoelectric Effect of Caesium Vapour," by Jacob Kunz, University of Illinois, Urbana, Illinois.

"An Electron-coupled Harmonic Amplifier," by David B. Chapman, University of Illinois, Urbana, Illinois.

Attendance at the meeting ranged from thirty to fifty.

Dr. Jacob Kunz, University of Illinois, was elected chairman for 1933-34.

(Signed) O. B. Young, *Chairman*

INVESTIGATION OF CABLE INSULATION BY IONIZATION CHARACTERISTICS

METHODS OF DETECTION AND MEASUREMENT OF IONIZATION IN DIELECTRICS *

BY

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SUMMARY

The results of the investigation on methods of detection and measurement of ionization in dielectrics may be summarized as follows:

(1) The assumption of the existence of surges and oscillations due to ionization in dielectrics has been experimentally verified.

(2) These oscillations were studied and utilized in the development of apparatus for detecting and measuring the relative intensity of ionization.

(3) Characteristic curves were obtained which correlate the applied voltage and the effective values of oscillations due to ionization. These curves make possible the study of the effect of applied voltage on certain properties of dielectrics and especially of cables.

(4) The existence of a time effect in connection with the intensity of oscillations due to ionization and the applied voltage has been ascertained.

(5) It was found that the time effect is characteristic of the quality of a cable in regard to impregnation and to a property which tends to shift the voltage at which copious ionization sets in.

(6) Ionization in a cable can be detected by radio-engineering methods, utilizing the electric impulses which ionization produces.

(7) A large range of frequencies was used in designing the apparatus. Frequency ranges as high as 30,000 kc. and as low as 100 kc. were tried and all gave similar results. Also audio-frequencies of about 2 to 5 kc. have been utilized in a great number of investigations on cables.

(8) The radio-frequency oscillations produced by ionization were utilized in three different ways. The first method was to amplify the magnitude of modulated radio-frequency currents and measure their effective values with thermoelectric and thermionic instruments. The second method was to apply intermediate detector action, and to measure amplified group frequency. The third method was to suppress the radio frequencies by rectification, and to select definite group frequencies for measurement.

(9) The utilization of lower group frequencies necessitated the use of special bridge arrangements for balancing the charging current. On the other hand the application of higher frequencies required special provision for guarding against interference from outside electromagnetic fields.

(10) The curves obtained with both types of apparatus are similar in character. They give the relation between the voltage applied to the cable and the intensity of the sum of the oscillations produced in a cable when ionization takes place.

(11) Both types of surge-measuring apparatus indicate the existence of bubbles and airpockets in a cable, if provision is made to prevent discharges taking place in transformers, condensers, and other parts of the circuits connected with the cable. They may thus be used as impregnation-testing apparatus.

* Published in full in University of Illinois Engineering Experiment Station Bull. 259, 1933.

(12) An application was made of the radio-frequency method to the testing of samples of paper moving between rotating nickel electrodes in air. Characteristic curves were obtained showing that the voltage at which corona discharge sets in, and the relative effective values of oscillations produced, are indicative of the character of the surface and texture of the paper.

(13) Methods have been devised for locating sources of ionization in cables. The underlying principles were verified by a number of experiments. Their applicability for testing of cables, however, was found to be limited to special cases.

Conclusions.—The following conclusions may be drawn from these results:

(1) In the oscillations associated with ionization in the form of discharges in dielectrics, especially in cables subjected to high alternating potentials, a clue has been discovered which makes possible the detection of early stages of deterioration.

(2) The various methods developed for measuring these oscillations have laid the foundation for the study of composite dielectrics from a new point of view, namely, that of correlating the processes which take place in dielectrics with the frequencies, amplitudes, and wave form of these oscillations.

(3) With the embodiment of these methods into apparatus new tools have been added to the equipment of research and testing laboratories. These apparatus may serve to control the processes of manufacturing condensers and cables, to safeguard their operation, and to assist in systematic work towards improvements.

A BALANCED BRIDGE FOR TESTING INSULATION*

BY

HUGH A. BROWN

University of Illinois, Urbana, Illinois

In the course of an investigation of the methods of testing high voltage cables apparatus for directly detecting the presence of ionization, discharges in the gaseous voids in the cable insulation under potential stress were evolved. The apparatus and method is readily adaptable to the testing of various types of dielectrics. To make the minute discharge detectable the 60-cycle cable charging current was balanced out with a special capacitance bridge. This bridge is composed of the cable under test, a discharge free zero loss air condenser and two resistance and inductance ratio arms. Variable resistance and inductance is placed in each ratio arm. The junction between the ratio arms was grounded, and the opposite junction (between cable and condenser) was connected to one high voltage testing transformer secondary winding terminal. The other terminal of this winding was grounded. This bridge is adjusted for an amplitude balance of the 60-cycle charging current of the insulation sample and air condenser. Phase balance need not be obtained. When the bridge is thus balanced the presence of the ionization discharges in the cable or other insulation sample can be detected by the characteristic sound in a telephone receiver connected to the output diagonals of the bridge through the medium of a bridge output transformer and a suitable vacuum tube amplifier. A preliminary amplifier followed by an effective inductively coupled filter is provided between the bridge output transformer and the final amplifier, to suppress the unbalanced 60-cycle residue and its harmonics. This makes the ionization discharge more readily

* Published in full in University of Illinois Engineering Experiment Station, Bulls. 259 and 260, 1933.

detectable, and with an output meter connected to the second or final high gain amplifier the comparative intensity of the discharges may be determined.

A known 5,000-cycle voltage is used to calibrate the entire apparatus. The coupled filter is designed to pass a band of frequencies of from 4,000 to 10,000 cycles. The conglomerate discharge frequencies lie within this band. When using a properly designed coupled circuit filter system between stages of the amplifier, the discharge free air condenser may often be dispensed with, so that the amplifier magnifies the ionization discharges. Disturbances caused by the ionization discharges are produced in the variable inductance in circuit with the cable, and these pass through the filter to be amplified. When the apparatus is used in this manner it is found that there is an optimum adjustment of the variable inductance in circuit with the cable for the greatest deflection of the output meter. Thus a complete or partial resonance effect of the circuit to the conglomerate discharge group frequencies of 4,000 to 10,000 cycles is indicated. The apparatus described may be used to test the variation of ionization discharge intensity in a cable with variations of cable voltage, time, cable temperature, etc. Peculiar behavior of the ionization discharges has been noted when such tests are made. Oil filled cable was found to be free from discharges, and the apparatus showed discharges to exist when a small amount of air was pumped into the oil filled cable through a hole in its sheath. If the output meter is replaced by a telephone receiver the presence of the discharge is recognized by a cracking or frying noise. In case of very minute discharges a fine sizzle or hissing sound is obtained. The sound characteristics of various kinds of discharges make an interesting study. The apparatus may be used to detect and measure the ionization discharges in other types of insulation, and it may be used to detect the presence of corona discharges at voltages considerably below those required to produce visible corona.

COMPARATIVE STUDY OF THE EFFECT OF DISCHARGES IN CABLES *

BY

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SUMMARY

Many peculiar and interesting characteristics of the detectable and measureable ionization discharge currents in paper-insulated cables were discovered. Among the more important is the fact that the insulation is a complex dielectric including solid, liquid, and gaseous materials, in which crystal and amorphous structures may change from time to time with changes in potential gradients, temperatures, chemical products of corona discharge, etc. Ionization discharge starts at a certain voltage impressed upon the cable and increases with the voltage, at first rapidly, then at a decreasing rate. In practically all cables the ionization discharge intensity, as directly measured with a bridge, will occur at voltages below those at which any change in power factor is noticeable. In many cases power factor remained constant, or decreased slightly with increasing voltage, but the ionization discharge intensity, although of low value, increased in proportion to the applied voltage raised to a power greater than unity.

* Published in full in University of Illinois Engineering Experiment Station Bull. 260, 1933.

Comparative studies and results indicate that the falling off characteristic of the ionization discharge with time is due to ionization discharges which are fixed locally in certain gaseous voids in the cable insulation. The cumulative rise of discharge current for the first minute is a phenomenon that has had no parallel which would suggest an explanation. When the ionization discharges do not fall off during the first 30 minutes it is believed that the discharges in the gaseous voids or spaces migrate or shift in their locality. Oil is drawn into electric fields, but special experiments showed that ionization discharges disrupt and scatter oil films in the vicinity of the discharges. Distribution of cable oil or compound is thus effected. This conclusion was arrived at by studies of thin transparent films of mixtures of saturant and air in which electric fields and ionization discharges were active. The increase in power factor did not follow the increase and decrease in ionization discharge immediately. The change in power factor may be due to an end result of previous time-ionization phenomena.

Practically all solid cables showed a certain amount of ionization discharge upon cooling from an elevated temperature down to some critical temperature above the normal ambient value. When a cable is in the process of deterioration, or when a local hot spot is present, the ionization discharge intensity at this particular interval of the cooling may reach intense values.

The impregnation of the paper and interlayer spaces often improves with use, due to redistribution of the saturant, infiltration of oil from joints, terminal potheads, etc.

Oil-filled cables were found to contain no ionization discharges either at operating temperatures or ambient temperatures.

New cables which have recently been manufactured, and have not been in use, nor out of the lead presses in the factory for more than one or two weeks often give ionization discharges which are greater in intensity than those occurring with these same cables, or like cables, when they have been allowed to stand or have been put into actual use. They show formation of voids upon cooling. These characteristic ionization discharges in new cables may in some cases result in slight damage to certain parts of the surface of the insulated paper before they shift or disappear, due to better distribution of the saturant. Although the power factor remained constant for varying voltage, the ionization discharge intensity increased with voltage.

Insulated wires may show considerable ionization discharge within the porous structure of the insulating material, particularly in the case of weather-proof wires, and also in the case of rubber-covered wire, to a certain extent, when the rubber has aged considerably. The existence of the ionization discharges in these pores evidently increases the potential gradient in the solid dielectric portions of the insulation in rubber insulation which has aged to a considerable extent.

Ionization discharges of considerable proportions will exist between the surface of wire insulation and a flat metal contact plate at potential gradients considerably below the value necessary for visible corona discharge, and investigation indicates that this invisible corona has a small but definite deteriorating effect upon the rubber insulation at the line of contact. The physical effect may be that of corona cutting on a small scale.

PHYSICS BOOKS OF HISTORICAL INTEREST IN THE COLLEGES OF ILLINOIS

BY

CLARENCE R. SMITH

Aurora College, Aurora, Illinois

The writer of this paper has been prompted to his theme by two experiences which came to his attention and by an experience of his own, all having to do with the resources of small college libraries in the line of old books. The personal experience was to find in the dead storage of the library of the college of his own employ, an old leather bound volume bearing on its back the simple title, "Newton's Chronolog." This book was stacked among other old theological books, and had been overlooked by many persons of theological interests who apparently did not stop to think that the writer of this volume might have been of far greater fame in other fields. Persons of scientific bent who had passed by this simple title probably did not consider that a writer of a book on theological matters could actually be the great "Sir Isaac" himself. The book was published in Dublin in 1728. How it came into our possession is a mystery except that it doubtless was in some one or other of the numerous private collections which have been presented to the college throughout the years of its history. The book is now in careful keeping and not classified among our resources in theology but a prized possession of our department of physics.

The ordinary college seems to be in a position almost unique for the collection of old books. The heirlooms from many a book lover fall into the hands of descendants who have other tastes. What more kindly disposition could be made of the books than to give them to the college which has already advertised the limitations of its library and its needs for help?

It seemed to be a worth while experiment to choose a field—in this case physics—and tabulate the resources of the various colleges of Illinois as to books of historical interest. The three larger universities of the State were not included since their resources would naturally be large and it was expected that they might obscure the main purpose of the project; namely, to organize resources not commonly recognized. To all the other institutions giving college degrees, a letter was written explaining the project and requesting them to send lists of their books in physics published previous to 1883 and written in English.

The list finally compiled includes 121 titles and represents the replies of sixteen colleges. Among the colleges which failed to respond, the larger institutions were most numerous, probably due to the larger amount of labor required to examine their more extensive collections. It is hoped that this report may serve to stimulate interest that will later lead to more extensive organization of this kind not only in physics but in other fields.

NOTE.—Mimeographed copies of the book list may be obtained gratis from the author.

Papers In Psychology and Education

Extract From the Report of the Section Chairman

The program of the Section in Psychology and Education consisted of four papers, all of which are here represented.

The acting chairman was reelected for the year 1933-34.

(Signed) Ralph W. Pringle, *Chairman*

THE QUALITY OF EXTENSION WORK

BY

CLEM O. THOMPSON

University of Chicago, Chicago, Illinois

ABSTRACT

Many criticisms have been made of the extension programs carried on by institutions of higher learning on the grounds that the quality of the work done by students in extension is beneath the level of academic respectability. Work done off campus in some instances may be of a questionable character, but there is no valid argument to support the conclusion that the extension method of instruction is fundamentally unsound when applied to certain subjects. Existing evidence indicates that this method of instruction, applied to non-laboratory courses, is equal if not superior to the classroom method. Supplementing the existing literature on this problem is a recent study made by the writer.

The data show clearly that students receive higher grades when studying by correspondence than when working on the campus. When the factors, instructors and courses, were constant, the difference in favor of students studying by correspondence is over one-half letter grade, and when the factors, students and departments, were constant the difference was over two-fifths of a letter grade in favor of work done by correspondence.

The quality of work done in extension classes is about the same as of that done on the campus. Here, when the factors, instructors and courses, are held constant the difference is two-tenths of a grade point in favor of studying in extension classes; when the factors, students and departments, are held constant, the difference, only one one-hundredth of a grade point, is in favor of work done on the campus.

The significance of these findings is pertinent to the training of teachers-in-service. All of us are aware that there are many teachers now at work who hold life certificates who, because of economic conditions, cannot attend formal classes. But by the extension method of study these teachers can be led to keep up to date. The extension method should also appeal to those who cannot afford to continue their studies toward the completion of a curriculum. May we arrive at the point where we measure an education for what it is worth, not by the geographical location of the student while at work.

THE UNMEASURED VALUES IN EDUCATION

BY

GEORGE D. WHAM

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ABSTRACT

Notwithstanding the acknowledged benefits of the use of standardized objective tests, a teacher may be permitted to doubt their present adequacy to measure the ultimate outcomes of education, and to raise the question of whether as commonly used they may not be producing an unwarranted over-emphasis of such outcomes as can be objectively measured, and conversely a wholly unwarranted under-emphasis, if not neglect, of certain tremendously significant values that cannot as yet be objectively and quantitatively measured. If teachers are judged wholly by objective results, naturally they will teach to secure outcomes that can be objectively tested; and just as naturally will they tend to lose sight of the imponderable and at present unmeasurable outcomes, however significant they may be.

Three great educational values are in constant need of emphasis: the *intellectual*, involving not only organized conceptual knowledge but also the cultivation of thought power in its use; the *ethical*, involving goodness and the cultivation of a sensitive concern for the welfare of all; and the *aesthetic*, involving beauty with its soul-stirring sublimation and glorification of the experiences that make up life. These three values I conceive to constitute the very essence of a civilized personality, the very outcomes essential to the operation of a successful democracy.

As previously affirmed, no one of these values has gone a great way toward adequate realization. Much less is there any objective or quantitative test now in existence that can enable a teacher to do more than conjecture how much capacity a given pupil may have in the future in any one of them. As to *thought power*, there is no way of telling how much ability a given pupil may have in future years to assemble his resources of knowledge and through sustained thinking arrive at a solution of some great and intriguing life problem. As to *ethical behavior*, there is no way of telling how much capacity a given pupil may have in the complex cross-currents of his future life to inhibit the selfish and shortsighted desire when promised the kingdoms of the world. As to *aesthetic appreciation*, there is no way of telling how much responsiveness a given pupil may prove to have to the massed glory of light and shade and color of a great picture, or which of two pupils will slump in his seat and which ascend to the seventh heaven in response to the tremendous tone pattern of stimulation of a symphony orchestra.

I may in closing be allowed to express again my misgivings that the success with which the outcomes of some of the techniques and the verbal formulations may be objectively measured may be contributing a sad by-product of neglect of these finer and far greater values that cannot be so measured. As some evidence that I am not wholly eccentric and unsupported in the position I have taken, I close by quoting a typical opinion of a thoughtful educator, Dr. Ambrose L. Suhrie, of New York University:

"The very gratifying progress we have made during the past decade or two in measuring native capacity and the more or less tangible aspects of achievement has unfortunately been accompanied by a deplorable neglect of many of those intangible aspects of spiritual growth which are as yet unmeasurable. We are sometimes almost forced to the conclusion that to do a little good we have quite unintentionally done a great deal of harm."

RELATIVE EFFECTIVENESS OF DIFFERENT REVIEW INTERVALS

BY

H. A. Peterson, Mary C. Ellis, Norine Toohill, and Pearl Kloess

Illinois State Normal University, Normal, Illinois

Very little of an experimental nature has been published on the question of when one should review. Lyon's work included no experiments on this question.[1] Our own are but a beginning.

(1) *Comparison of a two-day with a seven-day interval.* Here we compared the effects of a review placed two or three days after learning with one seven days after learning, the tests having been given on the 10th and 21st days after learning. The subjects were freshmen in elementary psychology at the Illinois State Normal University. The equivalent group method was used, there being three groups of 14 each in the first trial, and 21 in each of three groups in the second trial. Two trials were made to increase reliability. One of these groups reviewed two or three days after learning, the second, seven days after learning, and the third had no review. The materials were 6-page passages of historical and psychological reading matter of suitable difficulty. The directions were to study them in the manner customary in social science classes. The study time was 50 per cent more than the reading time of the selection. At the close of the study time a question-and-essay-answer test was given. The reviews were duplicates of the original learning conditions, except that there was no test. Ten and 21 days after learning all of the groups were tested, using the same test as on the previous occasion.

Results. In general there was a slight advantage for the shorter interval, but the difference was not great enough to be significant. We think that what happened was that the advantage of an early review before much fading out had occurred was about compensated for by the advantage of a review near testing time.

(2) *Comparison of a one-day and a nine-day interval.* Here each advantage was increased in intensity. The result was the same as before; the reviews after these intervals were approximately equally effective. In this experiment the subjects were sophomores, and the materials were of the ordinary sociological reading matter variety. One of them was 11 pages long and rather difficult.

Conclusion. While of course memory fades in the manner depicted by the usual curves of forgetting, the situation is complicated by the relation of the reviews to both learning and the times of reproduction. A review that occurs soon after learning rescues more from oblivion than one that comes later, but it is also longer in advance of the time when the information will be used than is the later review. In the cases tested above these advantages appear to be about equal in strength.

[1] Lyon, D. O., The Optimal Distribution of Time: Jour. of Ed. Psych., 1914.

A PSYCHOLOGICAL VIEW OF THE DEPRESSION

BY

J. A. Melrose

James Millikin University, Decatur, Illinois

The depression is called an economic depression because its acute symptoms are economic. The name is inadequate. We have economic plenty but bad distribution and the basis of the latter is inadequate social and moral thinking.

Human culture started with original nature and its needs. That nature and those needs are basicly unchanging. The latest baby born presents to our complex culture essentially the same nature that babies presented to incipient culture before the dawn of history. Culture is never "passed on"; it is created anew in each generation upon the original nature and needs of babies and growing youth. Original human nature started all culture and continues to be the basis of all sound cultural norms.

Man has a dual nature of '*feeling*' and '*sensation*' which function over definite and distinct mechanisms in his body. These basic factors of his nature and intelligence are the foundations respectively of his '*spiritual*' and '*physical*' experience and become generalized socially under the respective terms of *culture* and *civilization*. Feeling is the deeper element; it lodges close to the life of the self and responds to the sensory or physical world with accepting or rejecting reactions. It is the center of values and choice, viewed in common sense terms.

A well ordered culture must keep '*feeling*' and '*sensory*' factors in the same general relation to each other that they have by nature in the functioning of the human individual. Progress does not consist in a mere increase of material resources. It is a dual process depending upon the intrinsic duality of human nature and need. Social progress involves both a material advance and a progressive readjustment of this advance to human and social needs. When this latter adjustment lags a "moral deviation" occurs which threatens the stability of the whole culture.

The principle of coordination between the '*physical*' and the '*spiritual*' factors of human nature and human culture has the widest generality of all social principles. Religion (when not exploited) has addressed itself in all ages to the task of maintaining this basic cultural equilibrium. This is why all primitive religions consider their religion their "prosperity policy."

The Middle Ages overstressed *feeling* and built culture too much around it. They neglected *sensory* knowledge. Modern times reacted from this extreme and in time swung to the other extreme. There has been overweening interest in material progress to the neglect of values. This movement has in turn run its course and as there has been no adequate guidance back to cultural balance there has been going on a blind retreat back to feelings to be noted in individualism in thought, religion, and morals, and a lapse from the *head* to the *viscera* in expressionism in art, the cult of unintelligibility in literature, Emperor Jones in opera, and jazz in music. Material upperstructure cannot continue to rise while cultural foundations weaken and give way.

PAPERS IN ZOOLOGY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

The Zoology Section, after the first five papers on the program, divided into two groups to hear separate programs of eight papers in Zoology and seven in Entomology.

Articles not here represented are as follows:

"Morphological and Life History Studies on *Stylet cercariae*," by D. B. McMullen, Monmouth College, Monmouth, Illinois.

"Temperature Effects on the Heart Rate of Double Embryos of Fundulus," by Marie A. Hinrichs, Chicago (read by title).

"Some Studies on Guppyi, (*Lebistes reticulatus*)," by Vernice Rathwell Wodrich, Bradford, Pennsylvania (read by title).

"The Pretarsus (Articularis) in Coleoptera," by W. P. Hayes and C. W. Kearns, University of Illinois.

Average attendance at the meeting was thirty, maximum was forty-two.

It was voted to leave the selection of the chairman for 1933-34 to the Council.

(Signed) WILLIAM P. HAYES, *Chairman*

A CONCEPT OF SPECIES AMONG FISHES

BY

DAVID H. THOMPSON

Illinois Natural History Survey, Urbana, Illinois

AN ABSTRACT OF ORIGINAL OBSERVATIONS

Counts of the numbers of spines and rays in the fins of darters show that the degree of difference between the mean spine or ray counts of two populations increases as the water distance between these populations increases. It has not been possible to relate these differences in mean spine or ray numbers to differences in the environment.

During the past two years counts have been made of the spines and rays in the fins of many other kinds of Illinois fishes. By using the mean number of spines or rays in each of the seven fins of each of the spiny-rayed fishes of the state (a group comprising 47 species), we have been able to calculate coefficients of difference (the average of seven percentage differences) between any two species. These coefficients of difference for all combinations have been summarized in a table. From this table it is possible to construct a family tree showing the degrees of relationship of these 47 species, as well as their relative rates of evolution. This biometrical family tree of spiny-rayed fishes corresponds very closely to those family trees constructed by systematic ichthyologists from a much wider range of characteristics and is less open to criticism since it involves the experience and judgment of the investigator to a smaller degree.

Sterile hybrids are found in nature which involve six kinds of Illinois sunfishes. The occurrence of hybrids between certain described species and genera of sunfishes and not between others offers the possibility of an empirical test of the validity of coefficients of difference as indices of degree of relationship. The parents of 14 known hybrid combinations all show coefficients of difference below 4.7 per cent. Furthermore, combinations of these six species which are known to enter into sterile hybrids are the only ones which show coefficients of difference smaller than 4.7 per cent. Other nearly related species among which we are fairly certain hybrids do not occur show coefficients exceeding 5.7 per cent. For example, the two species of crappies, which from external appearances and general morphological characteristics resemble each other more closely than do many of the species which are known to hybridize, show a coefficient of difference of 5.7 per cent. Similarly, the large mouth black bass and the small mouth black bass resemble each other closely but show a coefficient of difference of 6.1 per cent.

The genetic meaning of this relation between hybridization and differences in the spine and ray counts of the fins is not clear. The most promising viewpoint seems to be that the *number* of spines or rays in a fin has little adaptive significance and that changes in the general genetic constitution produce random plus and minus variations in this number. Averaging the percentage differences of seven fins expresses the total amount of genetic difference between two species more accurately than does the difference in one fin.

BIOLOGY IN HUMAN BEHAVIOR

BY

C. E. Montgomery

DeKalb, Illinois

Although biology in one aspect or another has been a part of public education for nearly a half century, its real application to human life does not mean much to the average person of today. Except to those who have done special work in some field of biology, the year of required work in many of the higher schools means little more than another subject to fill up the curriculum. The lack of ability of the ordinary individual to see the importance of biology in its many applications to daily life should be the greatest concern of the teacher of this subject. This work should not be offered as a panacea for all human ills but to create a deeper understanding in the lay mind of the fundamental life processes. The fact that man is a member of the great living organization should place the subject of biology in the schools on the same plane as the conventional three R's.

Upon examination of the biological courses offered by the colleges and universities one need not be surprised to find the situation as it is. The old standard courses of botany and zoology are excellent for the specialist in these lines but they offer little useful material to the person who never does further serious work in biology. A large percentage of college graduates have had the regular year of work in some biology course, yet when faced with common community problems that involve biological knowledge they are no more able to aid the situation than those who have not been in college.

The forces of heredity and environment have so fashioned the human being that no clear understanding of the life of man is possible without a knowledge of both of these in their various relationships. One should know not only something of how heredity works but the nature of the living materials which are inherited and what environment does to develop it. Truly the biologist does not know all the facts about life, yet if the known facts should be impressed on the mind of the average layman, many problems of life would be much more easily solved. Crime, pauperism, health, recreation, sanitation, etc., are not merely social in character but are fundamentally biological.

The social worker, minister, teacher, judge of our courts and all others who are trying to alleviate human difficulties must of necessity know the nature of the chemical machine with which they are dealing. The failure of the human family to improve itself along with the development of its civilization is due largely to the lack of real information concerning its own animal nature.

The suggestions of this paper are offered to biology teachers with the hope that they may stimulate further consideration of the problem of bringing more practical phases of biology to the general student.

FAMILY ORIGINS IN A SOUTHERN ILLINOIS COMMUNITY

BY

CLARENCE BONNELL

Harrisburg Township High School, Harrisburg, Illinois

This is a study of family histories of 140 biology students in the Harrisburg Township High School in connection with similar studies over a period of years, made originally in relation to problems in heredity.

Harrisburg township is a typical Ohio River Valley community of 15,000 people situated twenty miles from the river. It has two main industries, farming and coal mining, upon which other industries depend. Many miners own their homes. Their children constitute a large part of the school and are among the best students.

Thirty years ago the population was stabilized. Almost any family name in the township could be found in some other similar Ohio River Valley community. Their ancestors had come largely by way of the Cumberland Gap or down the Ohio in the days of flat boats. Fully half of the students in 1933 had ancestry traceable to Kentucky, Tennessee, Virginia, Georgia, and the Carolinas. A later migration of Germans and Irish was also fused with the earlier comers. Strangely, not less than ten per cent of this stabilized population had some American Indian blood traceable to such tribes as the Pawnees, Cherokees, and Crows.

Development of the immense coal fields following 1900 brought many families from the Ozark Hills region in adjoining counties and from southern Indiana and Kentucky. These differed little in origins from those who had come in the century before. Soon a new element came, mostly Lithuanians and Hungarians. To this was added a few English and Scotch miners and a scattering of other Europeans. (The negro population is omitted in this discussion.) Thus, the population increased five-fold in thirty years.

The older English-Scotch-Irish-German-French-Dutch-Welch stock, which came during the nineteenth century and became amalgamated in the Ohio Valley, refer to the newer Europeans as "foreigners". This older group and their descendants have traditions retained from the days of trappers, Indian fighters, and Black Hawk, Mexican and Civil War veterans. The ancestral elements of this group are now so blended that they are discovered only by tracing the line of descent. The surnames no longer indicate national origins. All these groups, the older ones which came during the century after the Revolutionary War and the Europeans who came during the first twenty-five years of the present century, are now so well assimilated that their children in the high school of 1000 students are not distinguishable by speech, scholarship, manners, dress, physical appearance, or traditions. Outward appearances are gone although a foreign language is spoken in some of the homes and some of the children can speak one or more of them. Two more generations will see the family trees branching to include representatives of all these groups in nearly every family. With immigration limited and transportation and communication increased, and through the influence of schools, there will be nothing remaining in this community to distinguish national origins except as they may be traced in family histories.

ALBERTUS MAGNUS, THIRTEENTH CENTURY ZOOLOGIST

BY

SISTER MARY ELLEN O'HANLON

Rosary College, River Forest, Illinois

Albert Graf von Boldstädt, son of the nobleman, Count von Boldstädt, was born in Lauingen, Suabia in 1193. In his early youth he left his native home to attend school in Padua. There he entered the Dominican Order in 1223. After the completion of his studies he was given the work of teaching and of organizing schools. He taught at Hildesheim, Freiburg, Strasburg, Ratisbon, Paris and Cologne. At Paris he received the bachelor's degree and the licentiate. At Paris, too, he received the doctor's cap about the year 1245. His almost continuous program of study, teaching and writing was at least partially interrupted several times by the imposition of difficult offices of trust and dignity including the office of provincial of the Dominican Order in Germany, 1254-57, and the bishopric of Ratisbon between the years 1260 and 1262.

Of Albert's voluminous writing, *Opera Omnia*, including theology, philosophy and the natural sciences, two complete editions have been published, one at Lyons in 1651 in twenty-two folio volumes, and the other in Paris in thirty-eight quarto volumes in 1890-1899. The part of his works which treat of plants and animals is contained in the treatise on nature (Opus naturarum) and includes *De Plantis* and *De Animalibus*.

De animalibus is divided into twenty-six books; the first nineteen of these are based upon Aristotle's works on animals; the next two books deal with Albert's own observation on the form and structure of animal bodies, the perfections and imperfections of these forms and their causes. Books twenty-two to twenty-six inclusive contain the descriptions of a large number of animals many of which were described by Albert for the first time. The animals described include 113 quadrupeds, 114 birds, 130 aquatic animals, 61 reptiles and reptile-like animals, 41 worms and worm-like animals.

At the suggestion of Richard von Hertwig, Dr. Herman Stadler delivered a lecture entitled "Albert the Great as an independent student" before the Verein fur Naturkunde in Munich on March 20, 1905. Stadler published in 1916 and 1920 a complete edition of Albert's *De Animalibus* from the original Cologne manuscript. This splendid and elaborately indexed edition, dedicated to Richard von Hertwig and Erich Wasmann, S. J., appears as volumes 15 and 16 of the *Beiträge sur Geschichte des Philosophie des Mittelalters* and covers over 1700 pages.

Prof. Heinrich Balss, Haupt Conservator of the zoological collection of the University of Munich, published a monograph through the Munich press (1928) entitled *Albertus Magnus als Zoologe*. In this exposition of 115 pages there are nearly one hundred titles included in the bibliography and literature citations.

When one stops to consider that zoology was but one of practically all of the natural sciences among which Albertus Magnus divided his energies; and that perhaps an even greater amount was devoted to philosophy, theology, teaching and the many other responsibilities and occupations that crowded into and filled his life, there seems to be no other conclusion than that of George Sarton's that Albert's activity was nothing short of miraculous. (Introduction to the history of science, vol. 2, p. 933.)

Albertus, who because of his remarkable versatility won the two significant titles of "The Great" and "Doctor Universalis", was canonized nearly seven centuries since, Sanctus et Doctor Ecclesiae by the present reigning pontiff, Pope Pius XI, on December 16, 1931.

THE MOLLUSCAN FAUNA OF THE GREAT RIVER VALLEYS OF ILLINOIS

BY

FRANK C. BAKER

University of Illinois, Urbana, Illinois

The paper lists the Molluscan land species found in ten localities on the Ohio and Mississippi river banks from Hardin County on the Ohio northward to Jo Daviess County on the Mississippi. It shows that the number of species increases southward, certain species being found only in southern Illinois while others are restricted to the northern part of the State. The river bluffs are peculiarly adapted to the needs of land snails; they afford protection and food as well as moisture, and the numerous outcrops of limestone afford lime in abundance. Several races are confined to the large valleys. Two species, known only from the Mississippi River bluffs in the southern part of the State, are believed to be migrants from Missouri.

The paper is based on field work carried on for the State Natural History Survey during 1931–1932 for the purpose of obtaining data needed for the preparation of a handbook of the land mollusks of Illinois.

A SYNONYMIC CATALOG OF THE REPTILES AND AMPHIBIANS OF ILLINOIS

BY

WALTER L. NECKER

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ABSTRACT

The object of the paper was to present a complete bibliography of Illinois herpetology, with a concordance of the scientific names used, in the hope that a greater interest in our herpetofauna might be awakened and encouraged. Since there is at present insufficient Illinois material in museums to warrant a really comprehensive work on the reptiles and amphibians of this State, and since the only inclusive account was published over forty years ago, such a listing serves to bring the subject up-to-date for further research.

Sixty papers dealing with Illinois herpetology enumerate seventeen species of salamanders, nineteen of frogs, five of lizards, forty-one of snakes, and fourteen of turtles actually found. *Natrix sipedon confluens* Blanchard, not previously reported from the State, is added on the basis of specimens from Olive Branch, Alexander County, in Field Museum of Natural History.

The author urgently requests all persons interested in this part of our fauna to communicate with him and to cooperate in his work toward a "Herpetology of Illinois."

A STUDY OF THE PHARYNGEAL TEETH IN THE BLUNT NOSED MINNOW

BY

RAY CHAMBERS

University of Illinois, Urbana, Illinois

The taxonomic value of the teeth of fishes is readily expressed in the following quotation from D. S. Jordan, 1910. "No progress can be made in the study of these fishes (Cyprinidae) without careful attention to the teeth, as the genera are largely based upon dental characters." Cox, 1897 says, "It is often necessary to know the nature of the lower pharyngeal bones and teeth in identification, especially in suckers, minnows, and sunfish." Inasmuch as these characters have been stressed as taxonomic guides it is necessary to establish them as unvarying in order to give them their full value.

This account, a summary of the results obtained from a study of 56 specimens of the blunt-nosed minnow, shows that there are deviations in numbers and arrangement of the teeth in individual specimens as well as for different specimens of the group.

The pharyngeal teeth are situated on the pharyngeal bones of the fifth brachial arch. They are used as masticatory organs and possibly aid in affording the fish a chance to taste his food. The teeth are composed of the three tooth tissues. The prismatic structure of the enamel is not well marked and is probably absent in some cases. The cement is more appropriately named "bone attachment."

Fifty-six specimens were examined and it was found that 41 had the normal dentition formula of 4-4 as given by various authorities. The remaining 15 showed various deviations from the normal involving asymmetry between the two sides in the same fish as well as the presence of both supernumerary and subnormal numbers of teeth.

The size of the individual seemingly does not have any direct relationship to the number and arrangement of the teeth. This is shown by the fact that of a group of five specimens 48 mm. in length three had the normal dentition formula of 4-4, one of 4-4,1 and another of 2,4-4,2.

In some of the bony fishes teeth are "shed" but the old tooth functions until the new one is fully developed and ready for use. In one specimen there were four teeth on one side and three on the opposite side but there was not the slightest indication of regeneration of the "missing" tooth.

The main row of pharyngeal teeth is fastened directly and firmly to the pharyngeal bones. The median teeth are usually very broad and rather heavy with a sharp hook. Adjacent teeth laterad of the meseal series become longer, more slender, and more sharply hooked.

The secondary teeth are in a longitudinal row immediately posterior to the main row. They are arranged so as to fit between two teeth in the primary row and are fastened to the jaw by means of strong ligaments. The median secondary tooth is almost as heavy as the median primary one. It is broader and shorter with about the same angle of hook. It is less than one-third the length of the adjacent primary ones.

CONCLUSIONS

(1) The pharyngeal teeth furnish important data for identification of fishes but in the blunt nosed minnow neither the number nor the arrangement is absolute.

(2) The pharyngeal teeth are variable in form within the species or even in the same individual.

(3) In the blunt nosed minnow the size of the specimen has little or nothing to do with the number of pharyngeal teeth.

(4) The secondary row of pharyngeal teeth is not firmly attached to the pharyngeal bone.

SHELL INJURIES OF LAND MOLLUSKS

BY

T. Dale Foster

University of Illinois, Urbana, Illinois

ABSTRACT

F. C. Baker and others have called attention to the importance of the study of abnormal specimens of Mollusca in papers discussing monstrosities found in the Unios, with reference to variation and possible specific change. One type of abnormality which has no relation to the problem of evolution and yet has considerable biological importance is that sort of abnormality associated with or resulting from damage to the shell or to the animal. Under conditions of nature molluscs are constantly subjected to injury of the shell either by attack of predators or by accidental breakage. Studies of repair and abnormality due to injury to the mantle seem to be lacking in the recent literature.

For two years, monthly collections of land snails have been made in the vicinity of White Heath, Illinois, on the floodplain of Sangamon River. This habitat appears to be optimum for the development of *Polygyra thyroides* and *Polygyra pennsylvanica* because of their abundance. In making the October collection, a living specimen of *P. thyroides* was observed to be seriously injured, bearing a large irregular hole in its shell. This hole was so large that the foot extruded through it instead of through the normal aperture when the snail crawled. The specimen was brought to the laboratory and kept under observation. In 26 days the repair was completed and the individual was apparently normal except no cuticle was formed over the regenerated portion of the shell. The study of this individual suggested a statistical study of the adult shells in the combined monthly collections for evidence of mishap.

Of the 401 specimens of *P. thyroides* examined, 133 had recorded on their shells some form of injury. About 33 per cent of the adults were injured in some manner. Most of the injuries were of a minor character although about 5 per cent of the total number had injuries that involved serious damage to the shell. Sixty-six specimens of *P. pennsylvanica*, taken from the same habitat, exhibited about 15 per cent of the total injured of which again 5 per cent bore major injuries.

Injuries of like nature were observed to occur in other species found associated with these two species. No attempt is made to explain the cause of these injuries. The habitat is an undisturbed woodland on a river floodplain, free from domestic animals, so the snail injuries cannot be the result of their tramping. No doubt the amount of injury is closely correlated with the specific habits. Active species exhibit more injuries than the more seclusive forms.

These observations have particular value in demonstrating the extent to which repair is possible for the injured shells of land snails. The region of the aperture and especially the reflected lip seem to be particularly susceptible to accidental breakage but here the free edge of the mantle which secretes the shell facilitates reconstruction. Regeneration of broken areas far removed from the aperture gives evidence that the mantle surface is capable of reforming new shell material. In many cases traumistic injuries inflicted damage to the mantle and other soft parts of the body as demonstrated by abnormal form of the shell of the injured snail. In numerous specimens injuries to the mantle became perpetuated as spiral incised lines or ridges continuing in successive whorls as the shell grew in size beyond the damaged area.

A COMPARATIVE STUDY OF RIVER POOL AND POND COMMUNITIES, WITH SPECIAL REFERENCE TO THE SPHAERIIDS

BY

T. Dale Foster and William C. Van Deventer

University of Illinois, Urbana, Illinois

In connection with life history studies on the finger nail shell, *Sphaerium solidulum*, carried on at the University of Illinois under the direction of Dr. H. J. Van Cleave, observations were made concerning the habitat relations of this species.

Collections were taken from an oxbow pond near Muncie, Illinois. This pond formed part of the stream bed of Stony Creek until the stream was straightened during the building of a railroad grade in 1872. Part of the pond was deepened by removal of soil for the railroad grade. Since then the portion of the old stream-bed connecting the pond with the stream has been filled by sedimentation and the encroachment of vegetation. This area now supports cat-tail, willow, and button-bush. Elodea and algae grow in the pond near the shore.

The sphaeriids are numerically predominant in the pond community. A bottom sample from 1/16 sq. m. of bottom yielded 120 *Sphaerium*, 3 *Physa*, and 1 leech. Other animals taken at different times were: snails, *Helisoma* sp.; other sphaeriids, *Musculium* sp., and *Pisidium* sp.; mussels, *Uniomerus tetralasmus;* backswimmers; water beetles, *Pctlodytcs 12-punctatus;* burrowing dragonfly larvae, *Gomphus* sp.; mosquito larvae; red chironomid larvae; leeches; crayfish, *Cambarus propinquus;* amphipods, *Hyallela knickerbockeri;* isopods, *Asellus communis;* frogs, *Rana pipiens* and *Acris gryllis;* turtles, *Chrysemys* sp.; sunfish, *Lepomis* sp.; minnows, *Notropis* sp.; suckers, *Catastomus* sp.; mud cat, *Amieurus* sp.

Collections from pools connected with the stream in Stony Creek and in Salt Fork into which it flows yielded: crayfish, *Cambarus propinquus;* minnows, *Notropis whipplei, N. gilberti,* and *Hyborhynchus notatus;* suckers, *Catastomus nigricans;* black bass, *Micropterus salmoides;* isopods, *Asellus communis;* burrowing dragonfly larvae, *Gomphus* sp.; red chironomid larvae; mussels, *Lasmigona complanata, Cyclonaias tuberculata,* and *Lampsilis* sp.; water beetles, *Petlodytes 12-punctatus;* snails, *Goniobasis livescens;* sphaeriids, *Sphaerium solidulum* and other species of *Sphaerium;* Bryozoa, *Plumatella* sp.; caddis worms *Hydropsyche* sp.; mayfly larvae, *Hexagenia* sp., and *Heptagcnia* sp. Of these the crayfish were numerically predominant. The sphaeriids were not numerous.

Trematode larvae of the family Allocreadiidae develop in the sphaeriids of this locality. The metacercaria encyst in *Hexagenia* nymphs, and the adults are found in fishes (*Lepomis* and *Amicurus*). Thus the entire life history of these trematodes is accomplished within the pool community.

The stream-bed pools represent the earliest stage in a hydrosere leading to dry land. The pond fits into this sere, and the marshy area adjoining the pond represents a stage still more advanced. The pond has a number of species in common with the stream pools. These include *Cambarus propinquus, Sphacrium solidulum, Asellus communis,* the chironomid larvae, and some of the fish. Other species (as *Goniobasis, Hydropsyche,* and *Heptagenia*) taken in the stream pools are typically rapids forms which are only visitors to the pool community. Other stream pool species (as the *Hexagenia* and the mussels) disappear altogether in the pond. The sphaeriids, however, which occupy only a minor place in the stream pool community, become overwhelmingly predominant in the pond.

VARIATIONS AMONG ATYPICAL SPERMATOZOA IN VALVATA TRICARINATA

BY

C. L. Furrow

Knox College, Galesburg, Illinois

ABSTRACT

Among the gastropod molluscs the Prosobranchs present a variety of conditions of sexuality. The Prosobranchs, in fact, are, in a majority of instances gonochoristic, but, other members of the group are generally hermaphroditic. In certain other cases some members pass through phases in which the animals are first gonochoristic, then hermaphroditic, only to become, later on during the life cycle, gonochoristic or unisexual.

It appears significant, especially, in the light of recent investigations in sex differentiation that a series of variations should occur in the process of spermatogenesis in this hermaphrodite snail. In *Valvata tricarinata* the early gonial stages pass through separate strata during the period of sexual segregation, and later, spermatogenesis and ovogenesis occur at the same relative time. Always the male cells mature a short time before the ovocytes. It seems probable that the presence of a tendency toward increasing abnormality in the apyrene group may be the result of the interaction of the male and female systems which are so close together in the hermaphrodite gland.

Altogether three species of Valvata, one American and two European species have been studied to-date and each species has presented a widely differing set of conditions of spermatogenesis. *Valvata piscinalis*, which was first studied by von Kemnitz (1914), occupies a position in many respects similar to the unisexual gastropods. Von Kemnitz has established that only a single typical spermatogenesis occurs in *Valvata piscinalis.* Later, Artom and Cavallini (1931) in a careful study reported on both *Valvata piscinalis* and *Valvata cristata.* Their conclusions tend to confirm the work of von Kemnitz in showing again the total absence of an aberrant spermatogenesis in *Valvata piscinalis* and a definite tendency toward a typical spermatogenesis in *Valvata cristata.*

It is certain from a study of the conditions of sexuality in the three species of *Valvata* mentioned above that a series of increasing tendency toward aberrant spermatogenesis occurs in this genus with *V. piscinalis*, *V. cristata*, and *V. tricarinata* forming a series of increasing tendency toward a typical sperm formation.

INSTINCT BUT A RESPONSE TO THE LAW OF HABIT

BY

HENRY JAMES REYNOLDS

Chicago, Illinois

ABSTRACT

"Inherited habit" as applied to instinct is of course not new. I am however just now attempting to not only show that there is such a thing, but also to tell what it is and how it acts. The organism being but the sum total of its cell units is therefore a thing dominated by the cell. But the cell in its turn is also a thing dominated by what has gone before. It is but that which has been moulded and fixed by many repetitions in past generations—a thing dominated by what I would call the "law of habit." In the full article I have especially endeavored to bring out the following points:

(1) By no process of reasoning could instinctive knowledge in the newly born be accepted as a thing which had been imparted by the mother to the offspring through either teaching or example.

(2) When we fully realize that the cell never dies but merely divides or fertilizes itself, passes over to the next generation and there continues to live, then should we also know that acts in the newly born which were a part of the life conduct of the ancestors for many previous generations must be but the automatic repetitions in the new organism of such life conduct of the past.

(3) In setting forth the modus operandi by which this is done, I have sought to show, through a study of the *law of habit* that such repetitions cannot be other than simply that which is compelled by the operation of the uncanny principles of this law. The cell itself, in previous generations, having originally taken on the habit of breeding true through thousands of repetitions and then never dying simply keeps right on repeating in the new organism through the compelling influence of habit the same old practice. Habit having become master the act can not now be done in any other way than by the routine one which is directed by the habit.

(4) As an analogy, attention has been directed to the fact that such things as Leibnitz's law of continuity, Von Baer's law of embryonic development, Galton's law of regression, Mendel's law of heredity, and the fixity of "kind" which is everywhere apparent in nature, may also be all included in the same category. As the planets respond to Keppler's laws of planetary motion so the thing we call instinct, similarly compelled by the *law of habit*, becomes but another one of the great cycles and rhythms of nature. A fool-proof automatic thing in which neither brain nor intelligence is involved and which occurs alike in vegetable as well as in animal life.

(5) Finally, to better explain the thing we call the "homing" instinct, it would seem to be necessary to add to the "special senses" of touch, taste, smell, sight and hearing one or two other similar but yet unknown senses which, if they exist at all in man are today only rudimentary.

AMBYSTOMA TALPOIDEUM (GRAY) IN ILLINOIS

BY

Hilda A. Stein

Southern Illinois State Normal University, Carbondale, Illinois

ABSTRACT

During some explorations in November, 1931 in Southern Illinois, several specimens of the Mole salamander, *Ambystoma talpoideum* were found. The only previous record of this particular salamander's being found in Illinois has been the one made by Kennicott.

This time the collections of *Ambystoma talpoideum* were made on the island at Horseshoe Lake, a State Game Preserve about one mile south of Olive Branch and about fifteen miles north of Cairo. Originally Horseshoe Lake was an old oxbow of the Mississippi River and it is one of the few remaining original Cypress swamps in Illinois.

The particular area where the specimens of *Ambystoma talpoideum* were found was at the base of a sloping hillside which constitutes the shoreline of the island. Usually during seasons of high water this portion is flooded.

When found, *Ambystoma talpoideum* was under rotten logs buried in the ground about an inch or so. It had the characteristic lichen-like markings on its body making it harder to find.

Ambystoma talpoideum seems to be one of the rare species in this locality. Usually it is considered one of the southern salamanders. Finding it not only adds another record for its being in Illinois but also establishes a new northern limit for this southern species.

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NATURAL VS. ACCIDENTAL DEATH IN DIFFERENT HABITATS OF THE SNAIL *VIVIPARUS CONTECTOIDES*

BY

Harley J. VanCleave

University of Illinois, Urbana, Illinois

ABSTRACT

Different habitats for *Viviparus contectoides* have been studied in a detailed investigation of the life cycle (VanCleave and Lederer, 1932). Normally the females of this species have a life span of about three years, while males live but a little more than one year. In the Erie Canal (Durhamville, N. Y.) studies gave evidence that natural death is the chief factor reducing populations except for the young snails consumed as food by other animals. In the Illinois River (above Peoria, Illinois) entire populations of this snail are killed off by toxic effects of sewage. Evidences and interpretations are discussed.

BEYOND THE WALLS OF THE MUD-DAUBERS' NESTS

BY

Boyd B. Palmer

University of Illinois, Urbana, Illinois

ABSTRACT

A study of over 1,000 nests of the yellow mud-dauber, *Sceliphron cementarium* shows that three factors determine the location of nests—protection from rain, light, and enemies. Of these, protection from rain is perhaps the most important. In the matter of construction there appears to be no particular uniformity in the arrangement of their structures. Cells within the same nest may vary in size and shape. Of the number examined, only 41 per cent contained closed cells, 567 contained, besides the host, the prepupae of the blue wasp, *Chalybion caerulium*. Differences in the prepupae of both are described. A total of 233 closed cells were found to be entirely empty, and 523 cells were provisioned with spiders, with an average of four spiders per cell. The spiders used for provisioning the nests are listed, and also the parasitic and predaceous enemies. Among these a chalcid wasp, *Melittobia chalybii*, is the most important parasite.—*Abstracted by Wm. P. Hayes.*

SOME INFLUENCES OF MAN ON BIOTIC COMMUNITIES

BY

WILLIAM C. VAN DEVENTER

University of Illinois, Urbana, Illinois

ABSTRACT

The introduction of civilization into a primitive area involves: (1) extinction of the large and slow-multiplying animals; (2) destruction of climax vegetation and much of the animal life which depends upon it; (3) spread of certain plant forms which are man-tolerant, and essentially sub-climax in nature; and (4) modifications of number-relations among the smaller animal species which are man-tolerant. Some of these smaller animals merely adjust their habits so as to survive under the new conditions, usually with reduced numbers (skunks, opossums). Some, however, are actually benefited through an increase of food or of suitable breeding places, or through the destruction of their enemies (some rodents, birds, and insects). These are enabled to increase their numbers and extend their range. At the same time civilization brings with it a very definite biota of parasites and weed forms, both plant and animal, which are able to survive and propogate most successfully under man-influenced conditions.

Thus in areas where civilized man is well-established there are developed biotic communities of civilization which contain the following elements: (1) man, (2) domestic animals and plants, (3) man-tolerant native animals and plants, (4) imported weed forms, plant and animal, (5) parasites, native and imported. These different elements assume different degrees of relative importance according to whether we are studying (1) communities of man's dwelling and its environs; (2) communities of meadows, pastures, and cultivated fields; or (3) communities of relict woodlands and other semi-wild areas.

Conditions over a region may remain essentially primitive even though settled agriculture is practiced over certain portions of it. Such conditions persisted in Western Europe until about 1300 A. D. Up to this time great areas of forest remained uncut, and most of the larger animals were still found in them. During the period from 1300-1700 these forests were largely cut or burned, and the wild life destroyed. This period of biotic disturbance in Europe corresponds to the period from 1650-1880 in America, and from about 1820-1900 in certain parts of Australia. In all three cases the period was marked by destruction of natural conditions and wild life, and also by great increases in human population and extraordinary prevalence of epidemic disease.

Such a period gives way to one in which the destruction of natural conditions is largely completed. At the same time diseases tend to be endemic rather than epidemic. This change in the nature of their occurrence seems to be independent of any medical advance. Somewhat later, but belonging in the same train of events, the human population comes to increase much more slowly or actually reaches a level, and violent changes in the number-relations and range of animal species cease to take place. Thus the biotic community, with those elements eliminated which were not man-tolerant, and with the addition of the new elements which were brought in by civilization, strikes something like a balance.

NOTES ON THE FLIGHT AND ABUNDANCE OF THE SEED CORN BEETLE, *AGONODERUS PALLIPES* FAB.

BY

J. H. Bigger

Illinois Natural History Survey, Urbana, Illinois

The purpose of this paper is to assemble various scattered notes that have accumulated during several years relative to the flight habits of the beetle, which indicate that there are two definite flight periods each year, fall and spring.

Fall flight periods have been noted in the following cases: (1) Morgan county, October 1, 1925; (2) Calhoun county, October 2, 1925; (3) Calhoun county, September 9, 1927; (4) a flight late in September, 1932, which is well recalled, though the date was not definitely noted at the time.

Spring flights were noted as follows: (1) Macon county, April 12, 1923; (2) Pike county, March 25, 1925; (3) Morgan county, March 19, 1926; (4) Morgan county, March 23, 1926; (5) Greene county, March 22, 1928; (6) Sangamon and Christian counties, March 24, 1929; (7) Warren county, April 7, 1931; (8) Morgan county, April 9, 1933.

Specimens have also been noted as follows: (1) Adults under clods in a corn field, Adams county, May 5, 1925; (2) Adults under trash in field of clover, Morgan county, June 25, 1925; (3) Pupae and emerging adults dug from around roots of corn at Carlinville, Macoupin county and Lebanon, St. Clair county, June 26-27, 1930; (4) Pupae dug from roots of corn at Carthage, Hancock county, June 27, 1932 and adults emerged from this material July 5, 1932.

Table I

Infestation by the Seed Corn Beetle, Agonoderus pallipes Fab., in Four experiment fields, 1929-1932.

Treatment.	Per cent of infestation.				
	1929	1930	1931	1932	Average
Carthage					
Animal residue series	6.0	0.0	0.0	37.0	10.8
Crop residue series	.5	0.0	1.0	9.0	2.6
Clayton (Early plowed)					
Animal residue series	4.5	6.0	(a)	33.5	14.7
Crop residue series	0.0	2.0	(a)	21.0	7.7
(Late plowed)					
Animal residue series	6.0	5.0	(a)	25.0	12.0
Crop residue series	1.0	1.0	(a)	14.0	5.3
Carlinville					
Animal residue series	0.0	12.0	0.0	2.5	3.6
Crop residue series	0.0	1.5	0.0	2.5	1.0
Lebanon					
Animal residue series	.5	9.0	--------	--------	4.8
Crop residue series	1.0	2.5	--------	--------	1.8

(a) No records.

Hibernation as adults is indicated. Data suggest that the period of immature stages is from early May to late June or early July, 6-8 weeks. There is no evidence of a second brood, but it is shown that sufficient time elapses for it to be possible.

For the first time definite data are published showing the relative abundance of this insect under two rotation practices. Studies were carried on at experiment fields of Illinois Agricultural Experiment Station.[1] Table I gives records for two rotations, (1) Animal residue for fertilizer, four year rotation where manure precedes corn planting; (2) crop residue, four year rotation where sweet clover is plowed under as green manure crop preceding corn.

It appears that the adults choose an area where there is an abundance of decaying manure in which to feed and deposit their eggs. Feeding habits are not definitely determined. Time of plowing is not indicated as important.

[1] Cooperation of Dr. F. C. Bauer, in charge, Soils experiment fields, Illinois Agricultural Experiment Station.

CODLING MOTH HIBERNATION IN BANDED TREES *

BY

S. C. Chandler

Illinois State Natural History Survey, Urbana, Illinois

ABSTRACT

This paper is an attempt to answer the questions propounded by apple growers regarding the percentage of larvae of the Codling Moth *Carpocapsa pomonella* Linne, hibernating under treated paperbands placed around the trunks of the trees and the proportion wintering in other situations. Studies were made in orchards in southern Illinois during two winters on two ages of trees. The following table summarizes the data collected in these studies.

CODLING MOTH HIBERNATION IN BANDED APPLE TREES.

Table 1

A Comparison of Larvae in Band, on Tree, and on Ground.

		Per cent of Larvae Found in		
		Band	Tree	Ground
5 Trees 15-18 years.	Winter 1932-33	90%	3%	7%
9 Trees 25-28 years.	Winter 1932-33	77.8%	10%	12.2%
14 Trees Both ages.	Winter 1932-33	81.4%	8%	10.4%
3 Trees 25-26 years.	Winter 1931-32	78.8%	17.2%	3.5%
12 Trees 25-28 years.	Both winters	78.6%	14.8%	6.5%

Table 2

Distribution of Larvae over Tree

(Not including those in Band or Ground)

	1931-32	1932-33	Both Years
Base Line	9%	5%	8%
Base to Main Crotches	11%	9%	10%
Main Crotches	3%	9%	5%
Branches	76%	75%	76%

Table 3

Height above ground of the larvae in the branches

	1931-32	1932-33	Both Years
4-10 ft. above ground	65.3%	73.7%	71.5%
10 ft. and up	34.7%	26.2%	28.3%

* Contribution from Project 9.1 of the Ill. State Nat. His. Survey.

TABLE 4

Location of Larvae according to Types of Cover

(Not including those in Band)

(1) On Tree

	1932-33
Rough bark	38%
Punky wood (knot holes, etc.)	29%
Split branches	25%
Crotches	4%
Pruned branch ends	2%

(1) On Ground

	1931-33
Decayed twigs, old prunings	11%
Aphis injured roots	30%
Apples or apple mummies	24%
Sprouts	15%
Old pieces of bark	3%
Dead weeds	9%
Trash, artificial cover	11%

TABLE 5

Location of Larvae in present season's prunings

Three trees, 25 years old, averaged 10 larvae per tree in the prunings just cut off, which was 37% of all on tree except band.

CONCLUSIONS

(1) Treated bands are well worth while, catching over ¾ of the larvae wintering on the tree and the ground under it.

(2) Of those larvae not in the band a larger part are usually found on the tree than on the ground.

(3) Of those on the tree ¾ are found in the branches, and in trees of this size, 20-25 feet high, ⅔ of them will be wintering within 10 feet of the ground.

(4) Of those on the tree more than a third are under pieces of rough bark, but many of the rest of them are in places rather inaccessible to birds and to any spray material which may be developed.

(5) It is evidently advisable to burn prunings since they contain an appreciable percentage of the larvae on the tree.

TRANSACTIONS

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VOLUME 26 JUNE, 1934 NUMBER 4

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Minutes of Twenty-seventh Annual Meeting
Reports of Officers and Committees
Constitution and By-Laws

EDITED BY DOROTHY E. ROSE

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TRANSACTIONS OF THE ILLINOIS STATE ACADEMY OF SCIENCE

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BOTANICAL
GARDEN

Minutes of Meetings of the 1933-1934 Council

First Meeting

The first meeting of the Council was called to order at 8:00 a. m., May 6, 1933, at the Broadview Hotel, East St. Louis, Illinois, with Vice-President Behre in the chair. Members present were H. A. Ferguson and H. R. Wanless. Mr. A. E. Cockrum, chairman of the Junior Section, was also present.

The Council voted to hold the Twenty-seventh Annual Meeting of the Academy in Decatur early in May, 1934, with Mr. J. H. Ransom of James Millikin University as local chairman, subject to the approval of President-elect Hopkins.

The Council voted to allow honoraria of $150.00 each to the secretary and editor for the year 1933-34.

The following were appointed as a Committee on Ecological Survey:
A. G. Vestal, University of Illinois, *Chairman.*
W. G. Waterman, Northwestern University, Evanston.
V. O. Graham, 4028 Grace Street, Chicago.
V. E. Shelford, University of Illinois, Urbana.
W. C. Allee, University of Chicago, Chicago.
L. E. Sawyer, State Natural History Survey, Urbana.
C. E. Montgomery, State Teachers College, DeKalb.
John Voss, Manual Training High School, Peoria.
Mary M. Steagall, State Teachers College, Carbondale.

The following were named as members of the Committee on Conservation:
Henry C. Cowles, University of Chicago, Chicago, *Chairman.*
M. M. Leighton, State Geological Survey, Urbana.
W. H. Haas, Northwestern University, Evanston.
Jens Jensen, Landscape Architect, Ravinia.
Paul Houdek, 410 Gross St., Robinson.
R. B. Miller, State Department of Conservation, Springfield.
R. S. Smith, Department of Agronomy, Urbana.
H. F. Ferguson, Department of Public Health, Springfield.

The following were appointed a committee on Legislation and Finance:
A. C. Walton, Galesburg, *Chairman.*
John R. Neal, Springfield, Illinois.
A. S. Coggeshall, Springfield, Illinois.
A. C. Noé, Chicago.
W. C. Lodge, Monticello.

The following Committee on High School Science Clubs and Groups was chosen without approval of the chairman:
A. C. Cockrum, West Chicago, *Chairman.*
Miss Mabel Spencer, Granite City, Illinois.

JUL 16 1935

News Letter and Exhibits:
L. A. Astell, Kankakee, Illinois.
Expansion Program:
W. T. Maas, Dupo, Geology.
D. L. Barr, Cicero, Physics.
Rose Cassidy, DesPlaines, Chemistry.
H. L. Wright, Bloomington, Biology.
Rosalie Parr, University of Illinois, Urbana, University representative.
L. J. Thomas, Urbana, University representative.
One additional member is to be added to this committee to take charge of local arrangements for the Junior Section.

The following were selected a committee on the State Hall of Fame:
M. M. Leighton, Urbana, *Chairman.*
W. A. Noyes, Urbana.
H. J. Van Cleave, Urbana.
H. C. Cowles, Chicago.
A. S. Coggeshall, Springfield.
H. B. Ward, Urbana.
F. R. Jelliff, Galesburg.

No action was taken on the selection of a delegate to the Conservation Council of Chicago. Miss Dorothy E. Rose was appointed editor of the *Transactions* for the ensuing year.

The Secretary was authorized to arrange for the preparation of brief memorial articles to the three members of the Academy lost by death during the past year, U. S. Grant, J. P. Goode, and Abel J. McAllister.

The Council voted to ask the chairman of the Junior section and some representative delegated by him to attend the Council meetings during the forthcoming year. It was voted to allow the secretary to expend not more than $100.00 and the editor not more than $25.00 in connection with the duties of their offices.

The Secretary was authorized to send announcement of election to the newly elected members.

The meeting adjourned at 9:15 p. m.

Second Meeting

The second meeting of the Council was called to order at 1:00 p. m., November 18, 1933, at the Quadrangle Club, University of Chicago, with President Hopkins in the chair. The members present were C. H. Behre, G. D. Fuller, J. H. Ransom, and H. R. Wanless.

The minutes of the first meeting were read and approved. It was reported by the Secretary that A. S. Coggeshall had not accepted membership on the Committees on State Hall of Fame, and Legislation and Finance.

The Secretary reported that it had been impossible for the Committee on Publications to have the papers presented at the Section Meetings in Chicago, May, 1932, published in full with funds appropriated for the biennium 1931-33, and that approximately $2,000.00 appropriated for this purpose had lapsed June 30, 1933. The Committee on Publications has, since that date, secured abstracts from most of the authors of these papers of 1,000 words or less length, and these are now ready to be published. The Secretary also reported that $2,000.00 had been appropriated by the State for the publication of the Transactions during the biennium 1933-35. The Council approved the publication of the abstracts of papers presented at the Chicago meeting as Volume 25, No. 3, at an estimated cost not to exceed $500.00 and

of the reports of officers and committees made at the East St. Louis meeting at a cost not to exceed $100.00, according to estimates submitted by the Editor. The Committee on Publications was also authorized to assemble the material for Volume 26, Nos. 1 and 2, as quickly as possible. The Treasurer reported correspondence with the Postmaster at Springfield to the effect that the Academy's Second Class Mailing Permit would be valid if no numbers were omitted.

Plans for the Twenty-seventh Annual Meeting were discussed with Vice-President Ransom, but no action was taken. Mr. W. C. Spooner was appointed Chairman of the Zoology Section. The Secretary and Mr. H. F. Ferguson were appointed to choose a chairman of the Medicine and Public Health Section. It was suggested that the Agriculture and Economics Sections join in the preparation of a program in the field of agricultural economics.

The Treasurer reported that permanent funds of the Academy to the amount of $600.00 are invested in two real estate bonds, and that one bond with a value of $200.00 is being called in by a bondholder's committee consisting of officers of the University State Bank, Chicago. The Council voted to authorize the Treasurer to deposit this bond and to enter into the Council minutes of the following record:

> "1. That C. W. Hoff, Frank M. Kelley, and James W. Parker be and are hereby designated as one of the depositaries of the bonds of this Association, and that the officers or employees of said Association are hereby authorized to endorse, in the name of this Association for the purpose of deposit and collection in and with said bank, checks, drafts, notes and other like obligations, issued or drawn to and owned by said corporation, and it is further resolved that endorsements for deposit and collection may be by the written or stamped endorsement of the Association without designation of the party making the endorsement. Including the deposit of bonds with the above bondholders committee."

Mr. Ransom reported the selection of Miss Mary Brock to serve as Chairman of the Committee on Local Arrangements for the Junior Section, and Mr. F. C. Hottes to serve as Decatur member of the Committee on Membership.

Dr. T. H. Frison was appointed Chairman of the Committee on Conservation. Mr. V. O. Graham was appointed delegate to the Conservation Council of Chicago. The Secretary called attention to the fact that The National Forest Purchase Units in Southern Illinois, for which the Academy has been working for several years, are now being actually purchased by the Federal government.

The Secretary reported that Mr. A. E. Cockrum wishes to be relieved of his duties as Chairman of the Junior Section and the Committee on High School Science Clubs. The Council authorized Mr. L. J. Thomas and the Secretary to select a chairman for this committee. The Council appropriated to the Junior Section an amount not to exceed $30.00 in addition to the dues of affiliated High School Science Clubs.

The Council appropriated to the Committee on Membership an amount not to exceed $75.00 for the annual membership campaign.

The Council appointed the Secretary and Librarian as a committee to pass on requests of libraries for exchanges of publications with the Illinois Academy. The Librarian was requested to report to the Council the number of publications received by the Academy in exchanges, and their availability for use, and the degree to which they are used.

The meeting was adjourned at 4:00 p. m.

Third Meeting

The third meeting of the Council was called to order at 1:00 p. m., March 10, 1934, at the University Club, University of Illinois, with President Hopkins in the chair. The members present were H. F. Ferguson, G. D. Fuller, J. H. Ransom, and H. R. Wanless.

The minutes of the second meeting were read and approved.

The Secretary reported that Mr. Coggeshall, Librarian, has informed him that all exchanges which are received are marked as belonging to the Academy. These publications are at all times available for general use, but are not extensively used, because the Illinois State Library is housed in the same building and has duplicates of many of these publications. The Librarian was authorized by the Council to consider the feasibility of arranging for the shelving of these publications in the State Library, so that they might be more convenient for use, and to report to the Academy at its next annual meeting.

The selection of a delegate to the A. A. A. S. for the two meetings in 1934 was deferred until after the annual meeting.

In the absence of Mr. L. A. Astell, chairman of the Junior Section, the Secretary reported that a series of three broadcasts on the activities of the Junior Academy had been arranged over the University of Illinois Station W I L L, on March 17, 24, and 31. The Secretary also reported that the University of Illinois Station had suggested the possibility of a series of weekly talks on science for high school students to be presented during the school year 1934-35. This proposal was discussed, but no action was taken, pending further investigation of its practicability. At the request of Mr. Astell, a grant of $18.00 was approved, to be used to defray the cost of printing an April number of the Science Club Service leaflet. The first issue of this number was distributed in February to affiliated clubs and others interested in affiliation. The Secretary read a statement of the financial condition of the Junior Section prepared by Mr. Astell. Plans for the annual meeting of the Junior Section were discussed.

The Treasurer reported that about 400 members have paid their current years' dues, 240 are 1 year in arrears, 188 are 2 years in arrears, and 135 are 3 years in arrears.

The Secretary reported for the Committee on Publications that the publication of Volume 25, No. 3 has been delayed for several months, but that it is now being printed. The attention of the Secretary has also been directed to a statute relative to the State Division of Printing, stating that there must be omitted from material published by the State Bureau of Printing, "all journals and minutes of proceedings". This makes necessary the publication at Academy expense of minutes of council meetings, reports of officers and committees, lists of officers, the Constitution, and the program for the meeting. The Council approved the publication of the Preliminary program as one number, and of another number of each volume, including such administrative reports as are not eligible for publication at state expense. The reports of the East St. Louis meetings are now assembled and ready to be published within the next few weeks. The Secretary reported that the copy of the general addresses at East St. Louis, to be published as Volume 26, No. 2 and abbreviated summaries of the papers presented at the sectional meetings, to be published as Volume 26, No. 3, have been assembled, and will be edited and ready for submission to the Division of

Printing within a few weeks. Authors of papers to be presented at the Decatur meeting are being requested not to submit complete manuscripts of their papers, but rather short abstracts. The Secretary reported that several members had offered suggestions for accommodating the publication program to the present reduction in funds available for printing. The Committee on Publications was authorized to report at the annual meeting the policy which is to be adopted for the selection of material to be published in the *Transactions*.

The Secretary reported that satisfactory progress is being made on the section programs in Anthropology, Botany, Chemistry, Geography, Geology, Psychology and Education, and Zoology. Difficulties concerned with programs in Physics, and Medicine and Public Health, were discussed. The Agriculture and Economics sections and the Committee on Conservation are cooperating on a symposium on the Conservation of Illinois Resources. It was recommended that this program be presented at the General Session of the Academy. Mr. Ransom reported that the local committee is making satisfactory progress with the arrangements for the meeting. He suggested that two field trips be held, one geologic trip under the direction of Dr. M. M. Leighton, and one industrial trip, under the direction of Messrs. R. E. Greenfield and W. D. Hatfield of Decatur. The Council voted to allot not to exceed $50.00 to be paid to the speaker for the evening session. The President, the Secretary and Mr. D. L. Carroll were appointed as a committee on publicity for the meeting.

The Secretary reported that the addressograph plates and frames used in mailing the Academy's *Transactions* has been destroyed in the fire in the Springfield Arsenal. A committee consisting of H. F. Ferguson, A. S. Coggeshall and the Secretary was appointed to arrange for the making of new plates.

The Secretary reported on correspondence relative to relations between the Junior Academies of Science affiliated with the A. A. A. S., and the Student Science Clubs of America, which distributes the "Science Leaflet". No decision as to the policy of the Academy relative to this matter was made, pending further investigation of the problem.

It was reported that the University of Illinois Section of the American Chemical Society, and the Decatur Chemistry Club would meet jointly with the Chemistry Section of the Academy. It was suggested that these organizations, and the newly organized McLean County Academy of Science be invited to affiliate with the Academy.

The Secretary reported for the Committee on Conservation that a letter circulated by this committee had aided in the continuance of important researches on wild life carried on by the U. S. Bureau of Biological Survey, whose elimination has been proposed as an economy measure.

Word has been received that the Second Class Mailing permit of the Academy, used in distributing its publications, will be revoked if the next number is not in the mails by March 31, 1934. It is expected that Volume 25, No. 3, will be ready for mailing by that date.

The President appointed the following as a committee to audit the Treasurer's accounts before the annual meeting: A. C. Noé, Chairman; J. M. Beal; S. V. Eaton.

The meeting adjourned at 5:15 p. m.

Fourth Meeting

The fourth meeting of the Council was called to order at 7:15 p. m., May 3rd, at James Millikin University, Decatur, with President Hopkins in the chair. The members present were: C. H. Behre, G. D. Fuller, J. H. Ransom, and H. R. Wanless.

The minutes of the third meeting were read and approved.

The Secretary reported that since the last meeting of the Council Volume 25, Nos. 3 and 4, and Volume 26, Nos. 1 and 2 had been printed and mailed, and that he had been informed that the contract for publication of No. 3 of Volume 26 had been let. The publication of this number will bring the *Transactions* up to date.

The Secretary reported a request from Mr. J. C. Chiddix, Editor of the Illinois Chemistry Teacher, to publish in full chemical articles, of which the Academy *Transactions* would include brief summaries. It was voted that this request be approved.

The Council expressed appreciation of the active program which has been carried on during the current year by Mr. L. A. Astell, Chairman of the Junior Section and of the large number of clubs which have become newly affiliated through his efforts. It was recognized that Mr. Astell has not had adequate assistance in the handling of his large volume of correspondence. Accordingly, it was voted that he be asked to submit a preliminary budget at the beginning of the year for such expenses, for consideration by the Council.

Mr. Ransom reported for the local committee that everything is in readiness for the meeting.

The meeting adjourned at 8:00 p. m.

Fifth Meeting

The fifth meeting of the Council was called to order at 8:15 a. m., May 4th at James Millikin University, Decatur, with President Hopkins in the chair. The members present were: C. H. Behre, Jr., G. D. Fuller, J. H. Ransom, and H. R. Wanless. Delegates were also present from the Springfield Nature Society, Peoria Academy of Science, McLean County Academy of Science, and Knox County Academy of Science, all of which are affiliated with the State Academy of Science.

Delegates of the affiliated societies explained briefly the types of programs which are being carried on by their organizations. It was suggested that the Academy might be of real assistance to these affiliated societies in providing them with lists of scientists who might be secured to deliver addresses before their organizations at moderate costs.

It was suggested that a By-Law be prepared, for the location of the city where the annual meeting is to be held, two years in advance of the meeting, in order that each city might have the chance to profit by the experience of the committee which managed the meeting the preceding year. This was referred to the Committee on Resolutions.

The meeting was adjourned at 8:50 a. m.

(Signed) Harold R. Wanless, *Secretary.*

Reports of Officers and Committees For 1933-1934

Report of the Secretary

MINUTES OF THE TWENTY-SEVENTH ANNUAL MEETING, DECATUR

First Business Session

The first business session of the Twenty-seventh Annual Meeting of the Academy was called to order by President Hopkins at 8:50 a. m., May 4, 1934, in the Chapel of James Millikin University with thirty members present.

The President announced the appointment of the following special committees to prepare reports for the final business session of this meeting:

Auditing Committee: A. C. Noé, of Chicago, *Chairman;* J. M. Beal of Chicago, and S. V. Eaton of Chicago.

Nominating Committee: H. J. Van Cleave of Urbana, *Chairman;* Clarence Bonnell of Harrisburg, and H. F. Ferguson of Springfield.

Resolutions Committee: Fred R. Jelliff of Galesburg, *Chairman;* T. H. Frison of Urbana, and C. H. Behre, Jr., of Evanston.

Announcements were made by the chairman of the local committee. The business session was then adjourned until 11:45 a. m.

General Session

The general session of the Twenty-seventh Annual Meeting was opened about 9:10 a. m. in the same room before an audience of about one hundred and fifty.

President Hopkins delivered his address as retiring president of the Academy on "Recent Developments in the Chemistry of the Rare Earth Group."

There followed a symposium on the Conservation of Illinois Agricultural and Human Resources, which was attended by students of James Millikin University as well as members of the Academy. The addresses composing this symposium were on (1) "The Significance of the Conservation of Land Resources," by H. W. Mumford (delivered by Dr. C. L. Steward), Dean of the College of Agriculture, University of Illinois; (2) "The Relationship Between the Standard of Living and Natural Resources," by Simon Litman, Department of Economics, University of Illinois; (3) "Classification of Illinois Lands," by Raymond S. Smith, Professor of Soil Physics, University of Illinois; (4) "Soil Erosion Control Projects," by F. A. Fisher, Soil Erosion Service, and (5) "Utilization of Illinois Lands for Forestry, Wildlife, and Recreation," by T. H. Frison, Chief, State Natural History Survey.

Second Business Session

The second session of the business meeting of the Academy was called to order by President Hopkins at 11:45 a. m., in the same hall, with sixty members present.

Minutes of the first business session were read and approved.

The following reports were read and approved: Reports of the Editor, Treasurer, Librarian, Committee on Membership, Committee on High School Science and Clubs, Committee on Legislation and Finance, Committee on Conservation, Delegate to the A. A. A. S., Delegate to the Conservation Council of Chicago.

The Committee on Affiliation reported that applications for affiliation had been received from the McLean County Academy of Science and the University of Illinois Chapter of the American Chemical Society. It was voted that these applications for affiliation be approved.

No report was presented by the Committee on Ecological Survey.

The report of the Committee on State Hall of Fame recommended the discontinuance of this committee until there might be an improvement in general economic conditions.

There was some discussion of the publication policies of the Academy, and it was recommended that this subject be discussed further at the final business session at 5:00 p. m.

As no new business was presented, the meeting was adjourned at 12:15 p. m.

Third Business Session

The final session of the annual business meeting of the Academy was called to order at 5:10 p. m., in the same room by President Hopkins, with forty members present.

The minutes of the second session were read and approved.

The report of the Committee on Resolutions was presented by Chairman Jelliff. The report was accepted by vote of the members present.

The Committee on Nominations brought the following recommendations:

For President, Charles H. Behre, Jr., Northwestern University, Evanston; for *First Vice-President*, Charles D. Sneller, Peoria; for *Secretary*, the committee, realizing the importance of this office felt indisposed to attempt to name a successor to Dr. Wanless, and therefore recommended that the Academy delegate to the Council the selection of a secretary.

For the elective member of the Committee on Publications, Lyell J. Thomas, Urbana.

For the Committee on Membership: W. V. Balduf of Urbana, *Chairman;* Vida Latham of Chicago, A. C. Noé of Chicago, B. K. Richardson of Springfield, and one additional member to be selected by the Council after the place of meeting for 1935 has been determined.

For the Committee on Affiliation: J. C. Hessler of Galesburg, *Chairman;* H. H. Radcliff of Decatur, Rosalie M. Parr of Urbana, Mary M. Steagall of Carbondale, and E. M. R. Lamkey of Normal.

It was moved and seconded that the nominations be closed, and the Secretary be instructed to cast a ballot for the nominees. The motion was carried with no dissenting votes and the nominees were declared elected.

The report of the Auditing Committee was presented by A. C. Noé, and was accepted by vote of those present.

It was voted that the Committee on Publications be authorized to determine the publication policy of the Academy for the ensuing year. This committee was also authorized to consider the best place for the publications received in exchange by the Academy, and to report to the Academy.

The Secretary reported that the McLean County Academy of Science and several other individuals and organizations had invited the Academy to hold its 1935 meeting at Bloomington. An invitation for the 1936 annual meeting was presented by Dr. F. M. Fryxell of Rock Island. Other invitations were extended in behalf of Evanston, Carbondale, Harrisburg, and Rockford. It was voted that if and when the Academy should meet at Rock Island, the Council should attempt to arrange to hold a joint session with the Iowa Academy of Science, and that the same arrangement should be attempted with the Wisconsin Academy of Science in the event of a Rockford meeting.

As no further business was presented, the meeting was adojurned at about 5:40 p. m.

(Signed) Harold R. Wanless, *Secretary*

Junior Section Meeting

The annual meeting of the Section of High School Clubs was attended by more than 300 delegates and representatives of the fifty-seven affiliated clubs.

The summary of awards as outlined below indicates how the competition has come to challenge genuine effort on the part of all contestants in that no one club is able to carry away all the honors in few sections and in no division. The record of the Physics awards, it should be noted, in which the description of the entry, the name of the school and winner represents a model for emulation.

The full benefits of the news letter plan was not realized during the year. Accordingly, plans are being made to adjust this matter in the future.

The annual business meeting was held in the auditorium of the James Milliken University immediately preceding the program.

The four features of the program included: (1) an interest-creating, illustrated lecture on "Geological Adventures," by Dr. T. T. Quirke of the University of Illinois, (2) sound films on "The Molecular Theory of Matter" and "Oxidation and Reduction," courtesy of the University of Chicago Press, (3) Talks and demonstrations by student delegates as follows:

Geology: The Cahokia Mounds—Kenneth Laurent, Dupo Geology Club, Dupo High School.

Biology: The technique of making photomicrographs (lantern slides)—George Hatzenbuhler, Amateur Burroughs Club, Bloomington High School.

Chemistry: Silvering glass (demonstration)—Merritt Kreuzinger, Maine Chemistry Club, DesPlaines. The Romance of Rubber (lantern and demonstrations)—Elbert Drazy, Edisonian Science Club, Kankakee.

Physics: The Development of the Photo-electric Cell (demonstration)—Edward Koranda, Morton Physics Club, Cicero.

General: Variety in the Science Club Program—Charles Meyer, Vocational Science Club, Granite City;

and (4) presentation of awards by Dr. B. S. Hopkins, President of the Illinois State Academy of Science.

Following the program a tea dance was presented by the students of James Milliken in honor of the visitors.

Music for the banquet was furnished by Miss Vera June Appel, violinist and the Millikin Male Quartet.

After the banquet, Junior Section delegates joined with the members of the Senior Academy to hear Dr. George Finley Simmons of the University of Chicago, on the subject of "A Three-Year Windjammer Cruise to the Islands of the South Atlantic."

Of the field trips Saturday morning, the trip to the coal mine and the one to the starch works seemed to give rise to very great interest.

The committee is pleased to announce that after making a most intensive campaign, there is a small credit surplus and a stock of the last issue of "Science Club Service," with which to take up the work next year.

In some measure these items were made possible through personal donations. These included a cash donation applying to the May issue of Science Club Service, the seventeen-volume science encyclopedia for the club securing the greatest number of new clubs, and stenographic materials and services indicated elsewhere. It is hoped that this generous spirit may continue to aid the work until a financial plan may be evolved whereby the organization may grow into full stature.

Respectfully submitted,
(Signed) Louis A. Astell, *Chairman*

WINNERS OF AWARDS

First Grand Prize: Vocational Science Club, Granite City Community High School, Granite City.

Second Grand Prize: Edisonian Science Club, West Chicago High School.

Club securing greatest number of new members: Morton Physics Club, Morton High School, Cicero.

Biology

All-round Club: Amateur Burroughs Club, Bloomington High School, Bloomington, Illinois

Individual Poster

1. Granite City Community High School
2. Visitation High School, Chicago
3. Bloomington High School

Group Poster

1. Visitation High School, Chicago
2. Visitation High School, Chicago
3. Joliet High School

Individual Project

1. Bloomington High School
2. West Chicago High School
3. Bloomington High School

Group Project

1. Bloomington High School
2. Bloomington High School
3. Joliet High School

Commercial Projects, Individual

1. Joliet High School
2. Bloomington High School
3. Joliet High School

Commercial Products, Group

1. Bloomington High School
2. Kankakee High School
3. Joliet High School

Collections

1. Eastern Illinois Teachers College High School
2. West Chicago High School
3. Bloomington High School

Models

1. Joliet High School
2. Bloomington High School
3. (No entry)

Scrap Book

1. Joliet High School
2. Granite City Community High School
3. Joliet High School

Chemistry

All-round Club: Maine Chemistry Club, Maine Township High School, Des-Plaines, Illinois

Individual Poster

1. Wintress Selett, Normal High School
2. J. B. Sterne, Pittsfield High School
3. Eileen Culhane, Siena High School, Chicago
4. Marie Lawler, Siena High School, Chicago

Group Poster

1. Maine Township High School, DesPlaines
2. Dupo High School
3. Dupo High School
4. Morton High School, Cicero

Individual Projects

1. Leon Aikens, Dupo High School
2. Charles Burval, Maine Township High School, DesPlaines
3. Merritt Kreuzinger, Maine Township High School, DesPlaines
4. Robert Hooten, Bloomington High School

Group Projects

1. Maine Township High School, DesPlaines
2. Maine Township High School, DesPlaines
3. Maine Township High School, DesPlaines
4. Dupo High School

Commercial Products, Individual

1. Roland Kennedy, Granite City Community High School
2. Emma Jane Watkins, Normal High School
3. Marjorie Sanderson, Pittsfield High School
4. Normal High School

Commercial Products, Group

1. Pittsfield High School
2. Pittsfield High School
3. Visitation High School, Chicago
4. Normal High School

Collections

1. William Rapp, Granite City Community High School
2. George Franklin, Dupo High School
3. Harold Voss, Granite City Community High School

Models

1. Bill Eichelman, Jr., Maine High School, DesPlaines
2. Warren Mench, Maine High School, DesPlaines
3. Leon Aikens, Dupo High School
4. Leon Aikens, Dupo High School

Scrapbook

1. John Mason, Morton High School, Cicero
2. Marjorie Hanson, Normal High School
3. Florence Kukarski, Visitation High School, Chicago
4. Roberta Canady, Dupo High School

Geology

All-round Club: Bloomington Geology Club, Bloomington High School, Bloomington, Illinois

Individual Poster

1. John Gray, Bloomington High School
2. Robert Miller, Granite City Community High School

Group Poster

2. Bloomington High School

Individual Project

1. Robert Brown, Bloomington High School

Group Project

1. West Chicago High School

Collections

1. Edwin Olson, Bloomington High School
2. Leon Aikens, Dupo High School
3. Kent Adamson, West Chicago High School

Models

1. Normal McDonald, Dupo High School
2. Jack Mortimer, Bloomington High School

Scrapbook

1. Perry Burnett, Bloomington High School
2. Alvin Mercer, Granite City Community High School

Physics

All-round Club: Morton Physics Club, Morton High School, Cicero

Individual Poster

1. Streamlining. Edward Sigul, Morton High School, Cicero
2. Dry Cell. Emerson Horn, Mt. Pulaski High School

Group Poster

1. Machine Chart. Morton High School, Cicero
2. Short Wave Phenomena. Kankakee High School

Individual Project

1. Talking Light Beam. Robert Hale, Morton High School, Cicero
2. Demonstration of Induction. C. Meyer, Granite City Community High School

Group Project

1. Diving Helmet. Brant and Dell, Pittsfield High School
2. Air Compressor. Lacey and Heyday, Pittsfield High School
3. Conroy and Gray, Pittsfield High School

Commercial Products, Individual

1. Sound System, Louis Palnke, Kankakee High School
2. Commercial Photo Tube, Ed Koranda, Morton High School, Cicero

Commercial Products, Group

1. Telescope. Pittsfield High School

Models

1. Model Boat. Greeman, Kankakee High School
2. Two-cycle Engine. Pittsfield High School

Scrapbook

1. Albin Yasska, Morton High School, Cicero
2. Virgil Mercer, Granite City Community High School

Radio

1. Power Amplifier. Hruly, Morton High School, Cicero.
2. Power Wave Radio. Logan, West Chicago High School.

Junior High School

All-round Club: Vocational Science Club, Granite City Community High School, Granite City, Illinois

Individual Poster

1. Edward Durbin, Granite City Community High School
2. Richard Holshouser, Granite City Community High School

Individual Project

1. Robert Marker, West Chicago High School

Group Project

1. Vocational Science Club, Granite City Community High School

Collections

1. Edward Jenkins, Granite City Community High School
2. James Fuhrman, Granite City Community High School
3. Bob Suter, David Prince High School, Jacksonville

Models

1. Kenneth Richardt, West Chicago High School
2. John Dieter
3. Leonard Libby, Granite City Community High School

Scrapbook

1. Richard Holshouser, Granite City Community High School
2. Mary Madison, West Chicago High School
3. Virgil Blevins, Granite City Community High School

News Letters

Mimeographed

1. Kankakee High School
2. Granite City Community High School

Dittoed

1. Visitation High School, Chicago

Handcraft

1. Maine Township High School, DesPlaines
2. Morton High School, Cicero

Other Events

The afternoon was devoted to the meetings of eight sections of the Academy, which were held in various rooms at James Millikin University.

The annual banquet of the Academy was served to about 100 members and guests at the First Presbyterian Church. Following the banquet, addresses of welcome were given by O. W. Smith, Mayor of Decatur, and Jesse H. White, President of James Millikin University, and an illustrated lecture was given by Professor George Finlay Simmons of the University of Chicago on "A Three-Year Windjammer Cruise to the Islands of the South Atlantic."

On Saturday morning, four excursions were provided for members and guests of the Academy. Dr. William D. Hatfield conducted a trip to the Decatur Sewage Disposal Works and the Water Purification Plant. Dr. R. E. Greenfield conducted a trip through the plant of the Staley Corn Products Company. Dr. M. M. Leighton and Dr. George E. Ekblaw conducted a geological trip to study features in the glacial history of the Decatur region. Mr. D. W. Beggs and Dr. Gilbert H. Cady conducted a trip through the coal mine in the city of Decatur.

REPORT OF THE TREASURER

For Year Ending April 30, 1934

Receipts

Balance on hand May 2, 1933	$814.61	
Initiation fees and dues	704.00	
Allowance from A. A. A. S.	162.00	
Sale of *Transactions*	9.00	
Old debt paid for reprints	10.83	
Interest on bonds and savings	11.28	
Junior Academy	76.00	
		$1787.72

Expenditures

Expenses of annual meeting, 1933:		
Programs	$53.61	
Registration	25.00	
Officers' expenses	31.78	
Speakers' expenses	24.85	
Junior Academy	58.34	
		$193.58
Chairmen of sections, postage, etc.	42.05	
Junior Section, 1934	114.57	
Editor's salary, 1933	50.00	
Editor's salary, 1934	150.00	
Secretary's salary	150.00	
Printing Transactions	268.89	
Addressing Transactions, postage	52.74	
Expenses of Treasurer's office	90.64	
Expenses of Secretary's office	122.22	
Membership campaign	60.00	
Council meetings	20.08	
Refund on dues overpaid	4.00	
		$1318.77
Balance in University State Bank		468.95
		$1787.72

In presenting the above report, the Treasurer would call attention to the fact that collections have equalled those of the preceding year, while expenditures have somewhat increased. Much of this increase is due to bills from the year 1932-33. Considering the rather large expenditure for printing, the balance on hand is gratifying.

The present membership consists of 84 life members, 505 members fully paid up, 174 members in arrears for one year, 184 who are in arrears for two years, and 137 who are in arrears for three years. These last will be dropped from the rolls at the date of this meeting. We have received 40 new members during the year; 26 have resigned, and 6 have been lost by death. The net membership on April 30, exclusive of those who are being dropped at the present meeting, but including the paid up new members, is 985 personal members, and 70 societies and clubs.

The entire report is respectively submitted.

(Signed) Geo. D. Fuller, *Treasurer*

REPORT OF THE AUDITORS

Statement of resources as of April 30, 1934

Balance in University State Bank	$468.95
Mortgage bonds	600.00
Accrued interest	20.00
Office supplies	10.00
Total resources	$1098.95

We, the committee appointed to audit the report of the Treasurer of the Illinois State Academy of Science, have examined the accounts, which appear to have been correctly kept, and have verified the entries of expenditures against approved vouchers made by the President and the Secretary.

We find the balance in the bank of $468.95, and the mortgage bonds of $600.00 as reported April 30, 1934, to be correct.

(Signed) A. C. Noé
J. M. Beal
Scott V. Eaton

REPORT OF THE LIBRARIAN

The approximate number of Transactions on hand that were published since Volume 22 is as follows:

Volume 23, No. 1	100	Volume 24, No. 4	50
23, 2	Exhausted	25, 1	25
23, 3	Exhausted	25, 2	250
23, 4	Exhausted	25, 3	350
24, 1	50	25, 4	375
24, 2	100	26, 1	100
24, 3	Exhausted		

Sometime ago I made a suggestion to Dr. Wanless that as the Museum Library is not used to any extent by the public, the exchanges which are sent to the Academy be deposited in the State Library. Since making this suggestion I have taken up the matter with Miss Harriet Skogh, Librarian of the State Library, who assures me that they would be very glad to receive these publications as a *gift* to the State but they would be unable to keep them as a separate unit. They would have to be scattered on the shelves with the subject they represent. Miss Skogh feels that if they are made as a loan there would be great difficulty, if, at some future time the Academy wished to recall the loan. I would suggest that if some suitable arrangement can be made, the volumes be placed in the State Library as they, undoubtedly, would find a far wider field of usefulness than in the Museum Library. I wish to add that some years ago the greater portion of the State Museum Library was transferred to the State Library and only that portion remains in the Museum which is more or less in constant use by the Museum staff.

The approximate number of publications received by the Academy for the past year is seventy-five.

Respectfully submitted,
(Signed) Arthur Sterry Coggeshall, *Librarian*

REPORT OF THE COMMITTEE ON PUBLICATIONS

The report made by this committee at the 1933 meeting called attention to the continued delay in the publication of the *Transactions* of the Chicago meeting (1932). The general addresses presented at this meeting were published by the Academy in May, 1933. The committee was unable to secure the release of any additional funds from the appropriation for the biennium 1931-33 to publish the papers given at the section meetings at Chicago, and approximately $2,000.00 of the appropriation lapsed June 30, 1933. The budget of the State Department of Registration and Education for the biennium 1933-35 included an item of $2,000.00 for the publication of the Academy *Transactions*. In order that this budget might be spread over the two years, giving maximum benefit to the Academy, the committee, with the advice of the Council, decided to limit publication of papers presented at the section meetings in 1932, 1933 and 1934, to brief summaries. The manuscript of the number including the papers presented at the 1932 meeting was accordingly returned to the authors, and, during the fall of 1933, it was reassembled in abbreviated form. This was submitted for publication out of the new appropriation in December, 1933, but was delayed nearly three months before its final approval and publication as Volume 25, No. 4. In order to hold the second class mailing permit, the number including the reports of officers and committees at the Twenty-sixth Annual Meeting, 1933, was published by the Academy as Volume 25, No. 3. The preliminary program of the Twenty-seventh Annual Meeting was published during April, 1934, as Volume 26, No. 1, and mailed at the same time as the preceding number. The general addresses presented at the East St. Louis meeting have just been printed as Volume 26, No. 2, and are in the mails today. The summaries of papers presented at the section meetings at East St. Louis have been submitted for publication as Volume 26, No. 3 and the contract has been let. It will be ready for distribution later this spring.

The following is a summary of the publication of the year:

Volume 25, No. 2—1,500 copies, $170.00. Academy funds.
Volume 25, No. 3—1,500 copies, $96.84. Academy funds.
Volume 25, No. 4—1,500 copies, $952.89.* State appropriation.
Volume 26, No. 1—1,700 copies, $43.78. Academy funds.
Final program for 27th meeting—1,000 copies, $24.48. Academy funds.
Volume 26, No. 2 (in mails)—1,500 copies, $121.51.* State appropriation.
Vol. 26, No. 3 (in press)—1,500 copies, $289.54.* State appropriation.

The committee also reports the loss of all addressograph plates and bars in the State Multigraph Bureau, through the Springfield Arsenal fire. New plates are in the process of being prepared.

The committee wishes to express its regret to the members of the Academy and especially to the authors of manuscripts for the long delay in recent publication, for the necessary reduction in size of the *Transactions*, and for the diversion of a larger amount of Academy funds for publication purposes. The advice of the Council and past officers and other members was sought and generously received, and thanks are extended to those who aided the committee in explaining to officials of the State government the function of the Academy and the value to the State of the publication of its *Transactions*.

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* Preliminary estimate.

The committee has been informed of a statute governing the office of the Superintendent of Printing, which states that:" * * * there must be omitted all journals and minutes of proceedings. * * *" This requires the future publication of the minutes of business sessions and council meetings, reports of officers and committees, the constitution, the program, and any lists of present or former officers or committees to be published at Academy expense.

The committee has received from some members alternative plans for the solution of its publication problem. These suggestions have been gratefully received and considered. The following suggestions are excerpted from such letters:

(1) Reduction of the maximum allotment of space per author from 20 printed pages to 2,000 words.

(2) Selection from all the papers presented at each annual meeting of a few outstanding papers which would be published in full.

(3) The printing of an abstract of each paper presented at the meeting, with the statement that a copy of the full paper might be secured for exactly the cost of having a copy typewritten. Each manuscript in full would then be filed with the librarian of the Academy, who would take care of such requests for the full papers as may be received.

A study of the publication policies of other State Academies of Science which issue transactions reveals a range in space devoted to single papers from a short paragraph to 200 pages.

The committee would welcome further suggestions by the membership of the Academy toward the establishment of a permanent publication policy, either at the present business meeting, or in writing, to the committee for 1934-35.

(Signed) B. Smith Hopkins
H. R. Wanless
Lyell J. Thomas

REPORT OF THE EDITOR

The December issue (No. 2) of Volume 25 of the Academy's Transactions, containing papers presented in general sessions at the Chicago (1932) meeting was published in June, 1933. Funds were not released for further publication until March, 1934.

In order to meet post office requirements and prevent the quarterly mailing permit from lapsing, it became necessary to designate the issue containing the minutes of the Twenty-fifth Annual Meeting as No. 3 of Volume 25, which was distributed late in March of this year. Papers presented at the Chicago meeting constitute No. 4 of Volume 25, and was distributed together with No. 1 of Volume 26, Announcement of the Twenty-seventh Annual Meeting, in April, 1934.

Papers presented in general sessions at the East St. Louis meeting comprise No. 2 of Volume 26, which has just been distributed. No. 3, consisting of papers presented in section meetings at East St. Louis is now in press. Its distribution will bring the Academy's printing program up to date.

Respectfully submitted,

(Signed) Dorothy E. Rose, *Editor*

REPORT OF COMMITTEE ON AFFILIATION

The two applications for affiliated membership that have come to the attention of the committee are those of the McLean County Academy of Science and of the University of Illinois Section of the American Chemical Society. These, as the committee understands, have already qualified for membership. The committee therefor recommends their admission to affiliated membership.

(Signed) John C. Hessler, *Chairman*

REPORT OF MEMBERSHIP COMMITTEE

In the campaign for new members this year, nominees were addressed as usual, and the personal solicitation method was stressed more than usual. In addition, special attention was given to the field of education, in an effort to build up a stronger section of psychology and education. An effort was also made to secure greater representation in the Academy from the members of the Illinois Biology Teachers Association, which is an affiliated organization. Many nominees declined their nominations by letter on the basis of financial inability to take advantage of the opportunity of joining, although they expressed the wish of doing so in the near future. On the whole, however, the number of new members secured (40) indicates a fairly successful campaign considering the prevailing economic situation.

The Council of the Academy appropriated the sum of $75.00 for membership campaign expenses. Expenditures totaled $67.40, leaving a balance of $7.60.

Respectfully submitted,

Don L. Carroll, *Chairman*

REPORT OF THE COMMITTEE ON HIGH SCHOOL SCIENCE AND CLUBS

Following the resignation of the Chairman, Mr. A. E. Cockrum, the committee held its first meeting during the High School Conference at the University of Illinois. Perspective for the problems at hand represented the chief outcome of this meeting.

With a budget allowance from the Senior Academy Council on which to work, the initial step in the campaign for new clubs and retention of old ones, was the preparation and mailing of approximately a thousand copies of the first issue of the Science Club Service leaflet with accompanying form letters. The results were sufficiently gratifying to warrant the belief that with greater effort still greater results might be had. The chairman accordingly proposed that radio facilities be obtained with the understanding that script for the speakers to draw upon would be supplied by him. Five such radio programs were scheduled with speakers in the following order: Dr. L. J. Thomas, Dr. H. R. Wanless, and Dr. B. S. Hopkins, all over Station W. I. L. L., and Dr. Charles H. Behre, Jr., followed by Dr O. D. Frank over W. G. N. An additional talk over K. Y. W. was given by the chairman on the subject of "Science Club Work for the Changing Social Order," under the

auspices of the Men Teachers Union of Chicago. This series of talks created more interest than any single form of attack thus far inaugurated. One reason for this was found in the fact that post-card announcements of the series were sent out in advance.

In order to reduce the mass of correspondence that would naturally arise from such a series of talks, a second issue of the Science Club Service was prepared and mailed to all contacts as well as affiliated clubs. This issue of the leaflet contains such inspirational and staple information as to be useful in the early fall campaign for new club affiliations, and there is a sufficient supply to meet these needs if the mailing list is carefully selected, a detail which the chairman will be glad to work out.

The work of the Junior Section could not have been carried to its successful conclusion without the generous support of the Senior Academy and the various individuals and organizations. It is a matter of personal pride to note that the Junior Section has not used all of the budget allowance made possible by the Senior Academy this year. The Junior Section through its active committee desires to thank the Senior organization for all the support it has received, both financially and cooperatively. It further desires to express its appreciation to the following: To Dr. H. R. Wanless for obtaining station time over W. I. L. L.; to Dr. C. H. Behre, Jr. for such time over W. G. N.; and to all the speakers who participated in the work; also to the W. M. Welch Manufacturing Company, the Illinois Biological Teachers Association, and the Illinois Association of Chemistry Teachers for loving cups; to the administrative and commercial departments of the Granite City Community High School, the Maine Township High School; and the Kankakee High School for stenographic and clerical assistance; and finally to those generous individuals who have made voluntary cash contributions to the end that the various aspects of the work might move without interruption.

It should be remembered that the economic conditions through which the public schools of the State as a whole have been passing, has not shown the improvement reflected in the business world. Nevertheless, it is interesting to note that the Junior Section moved forward in unmistakable ways. It has broken all previous records in the total number of affiliations maintained; all previous records in the total number of members in such affiliated clubs; all previous records in re-establishing clubs with dues two or more years in arrears; and, we believe that it will reflect this solidity of growth through the most satisfactory meeting it has had when viewed from every angle. An analysis of the affiliation records may be summarized as follows: 1930—27 clubs; 1931—40 clubs; 1932—41 clubs; 1933—24 clubs; 1934—57 clubs.

Recommendations for the furtherance of the work include:

(1) Changes in the Constitution and By-Laws of the Junior Section, to include provisions for chairmen as follows: (a) Radio Service, (b) Expansion and Editorial Service, (c) Zone Activities on the basis of six zones embracing from four to 23 counties each. The promulgation of this work has been delegated to Dr. Lyell J. Thomas of the Advisory Committee.

(2) The continuance of the Science Club Service leaflet on the basis of two to three issues per year, depending upon the growth of the organization, and with the last issue of the year designed to serve the purposes of the affiliated and contact group for the moment, also to serve as the campaign issue for the following season.

(3) The development of the Advisory Committee. The details of this recommendation are left in the hands of the present Advisory Committee.

(4) The consideration of the nominations for the expanded Junior Committee as presented by Dr. Rosalie M. Parr, Chairman of the Nomination Committee.

(5) That any action on the part of the Senior Council to include the Chairman of the Junior Section as a member of its group, might well carry with it the provision that such chairman would be ineligible to attend these meetings unless he or she personally was a member of the Illinois State Academy of Science.

A cumulative financial record has been maintained in the correspondence directed to Dr. George D. Fuller, Treasurer, as dues made payable to him were transmitted by the chairman to him.

It is believed that no organization ever worked under a more harmonious influence, and that everything possible has been done to make the work efficient, effective, and economical.

REPORT OF THE COMMITTEE ON LEGISLATION AND FINANCE

The work of the committee during the past year has been centered around the question of finances for the publication of our *Transactions*. In spite of the work of the various members of the committee, both by correspondence and by personal visits, and the very efficient assistance of our Secretary, it was impossible to obtain the release of the balance of two thousand dollars ($2,000) in the appropriation given the Academy by the preceding administration. It was possible, however, to obtain a reduced appropriation in the new budget. This has been finally released and the members already have received their copy of the first of the *Transactions*, which had been held up because of the question of finances.

(Signed) A. C. Walton, *Chairman*

REPORT OF THE COMMITTEE ON STATE HALL OF FAME

The committee has nothing to report except that the financial conditions during the past year have not been such as to warrant any consideration of a State Hall of Fame.

This matter will need to await more favorable conditions in the State, in spite of the fact that it would be appropriate for the State to recognize its outstanding men in the scientific world.

I therefore suggest that this committee be dissolved with the expectation that the matter will be brought before the Academy again in due time.

Respectfully submitted,

(Signed) M. M. Leighton, *Chairman*

REPORT OF THE DELEGATE TO THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The representative of the Illinois State Academy of Science attended the meeting of the Academy Conference section of the American Association for the Advancement of Science at Boston during the Christmas holidays, and completed the committee work in that Conference which he had been carrying on as past-Chairman of the Conference group.

The meeting at Boston was primarily centered around two questions. The first dealt with the question as to the credit value which should be attached to a clock hour spent in laboratory or field work. While this question aroused considerable comment from laboratory men that they felt not enough teaching credit was being awarded for such work, nevertheless the general opinion was that the problem was primarily one for administration rather than for faculty settlement.

The second question of discussion was as to the attitude that the various State Academies, which have adopted the Junior Academy movement, should have toward the new national organization of High School Science Clubs which was being sponsored primarily by the Chemistry people. The matter was referred to the various State Academies for consideration and suggestions. The result is to be reported at the next meeting to be held in Pittsburg in 1934. Meanwhile it was urged that all states engaged in, or contemplating, Junior Academy organization should not let down their efforts in this direction because of the present apparent competition aroused by the new organization. Your delegate has reported the matter to the Council of the Academy and the matter now rests in their hands awaiting their decision.

Respectfully submitted,

(Signed) A. C. Walton, *Delegate*

REPORT OF DELEGATE TO ILLINOIS CONSERVATION COUNCIL

The Council represents about sixty different organizations. The meetings are held the third Thursday of each month from October until May at the Morrison Hotel in Chicago.

The aims of the organization are first to inform the delegates concerning various conservation movements taking place throughout the country, and second to serve as a clearing house for conservation ideas in order that action may be directed along lines in which all organizations may be in agreement.

The year has seen great forward steps in conservation due chiefly to the leadership in Washington. The Everglades as a national park has again drawn the attention of Congress and many places have been proposed that have no claim for any place in our consideration for national parks. National forestry has been in the center of attention. Illinois has been granted six hundred thousand acres in the southern part of the State, the beginning of what will be a national forest in the future. Several million acres must eventually return to forestry in this State if our resources and scenery are to be returned to a reasonable condition. The State has been handicapped by the depression in its movement to add to the State parks.

In spite of the depression much more has been gained than is usual in any one year.

Respectfully submitted,

(Signed) V. O. Graham

REPORT OF THE COMMITTEE ON CONSERVATION

The present organization of your Committee on Conservation was not established until about six months ago. Shortly thereafter it was felt that a vigorous protest should be lodged with all the United States Senators and Representatives from Illinois, members of the special Wild Life Committee of the Senate, and the Sub-Committee of the House dealing with agricultural appropriations against the elimination of three fundamental and important divisions of work of the U. S. Bureau of Biological Survey. It was felt that the elimination of this fundamental scientific work at a time when conservation activities were being pushed at an accelerated speed and when trained leadership was needed more than ever was inconsistent, unsound, and false economy. This committee's letter of protest was read at the appropriation hearings in Washington and the prompt response and action of our Illinois Senators and Representatives was extremely gratifying. I am glad to report that this protest, together with those of other organizations throughout the country, led to the reinstatement of the desired appropriations in the budget and the final passage of the appropriation bill.

Since the last meeting of this Academy, the establishment in Illinois of the Shawnee and Illini National Forests has been approved by the Federal Commission. At the present time the U. S. Forest Service has options on about 100,000 acres of the 600,000 within the area of the two Illinois National Forest Units as now defined and the actual purchase of this land will soon be an accomplished fact. An office of the Forest Service for the immediate supervision of these newly established units has been established at Harrisburg, Illinois. It will be recalled that this Academy has helped support the move for the establishment of National Forests in Illinois ever since this movement was started by the State Natural History Survey and the Illinois Agricultural Experiment Station.

It is hoped that this committee can play in the future an increasingly important part in conservation policies and activities of this State and the nation.

Respectfully submitted,
(Signed) T. H. Frison, *Chairman*

REPORT OF THE COMMITTEE ON RESOLUTIONS

I. Whereas, In view of the national migratory waterfowl situation and the great importance of the Illinois River valley as a migration route for many species of waterfowl now greatly reduced in numbers, be it therefore

Resolved, That this Academy urges and endorses the acquisition by the Federal Government for a wild-life refuge or sanctuary of a large tract of water area and submarginal land in the Illinois River valley between Pekin and Beardstown as mapped, described, and presented to President Roosevelt's Wild-Life Restoration Committee by the Illinois State Natural History Survey, the Illinois Agricultural Experiment Station, and a special committee of the Ecological Society of America.

II. Whereas In Illinois there is a serious need for a varied and broad land utilization program and since such programs to be most effective must rest upon impartial and scientific data, be it therefore

Resolved, That this Academy goes on record as endorsing the past and present programs of the State Scientific Surveys and the Illinois Agricultural Experiment Station and further that these fact-finding research organizations supply the leadership in the evaluation and scientific guidance of land utilization problems in this State.

III. Whereas In Illinois there are 4,800 square miles of land subject to destructive erosion, 4,600 square miles subject to serious erosion, and 19,700 square miles subject to harmful erosion, be it therefore

Resolved, That this body endorses the splendid accomplishments of the Civilian Conservation Camps in this State and urges the continued maintenance and operation of these camps in furthering the development of State and National forests and erosion control projects.

IV. *Resolved*, That we express our feeling of regret and sorrow for the death of the following members:

Dr. C. C. Farrington, Field Museum, Chicago, Illinois.

A. S. Galajikian, Knox College, Galesburg, Illinois.

Arthur J. Mason, Homewood, Illinois.

Sylvester Miller, 1344 Garfield Avenue, Aurora, Illinois.

Marie A. Prucha, 2530 South Clifton Park Avenue, Chicago, Illinois.

Jesse L. Smith, Highland Park, Illinois.

We feel that in their deaths the State Academy has suffered a distinct loss and shall gratefully remember them for their virtues and accomplishments.

V. *Resolved*, That the State Academy of Science views with great pleasure the fine work being done by the local academies of the State, now affiliated with the State Academy, and we recommend that the Council be authorized to prepare a list of speakers, who can be made available to these local academies at minimum expense.

VI. Whereas, The present policy of the Illinois State Academy of Science is to assign the place of the Annual Meeting of the Academy only one year in advance and

Whereas, It is desirable for numerous reasons to systematize places for future meetings in the interests of equable geographic distribution of meeting places, be it therefore

Resolved, That an additional by-law be enacted as follows: "The Council elected for the year 1934-35 is empowered to select the place of the Annual Meetings for May, 1935, and for May, 1936. Thereafter each successive Council shall select the place of the Annual Meeting for the spring of the first year following the retirement of said Council, except when unforeseen circumstances make it necessary for said Council to act with respect to the more immediate meeting as well."

VII. Whereas Mr. Louis A. Astell has shown exceptional devotion, energy, and skill in furthering the work of the Junior Section of the Academy of Science and of the affiliated high school science clubs, be it

Resolved, That the Illinois State Academy of Science express its hearty appreciation in the strongest terms of the excellent work of Mr. Astell and do whatever may be in its power to assist him in its furtherance.

VIII. *Resolved*, That the resolutions adopted at this meeting be placed on record and that copies of pertinent resolutions be duly transmitted to interested persons.

IX. *Resolved*, That we thank the officers and Council of the Academy for their efficient services during the past year.

X. *Resolved*, That the State Academy extend its grateful appreciation to the local committee, whose efficient service has made this meeting possible; Dr. J. H. Ransom, for his individual efforts; to The James Millikin University, for the use of its buildings; to the Decatur press for its generous publicity; and all other organizations and individuals who have contributed to the success of the sessions.

(Signed) Fred R. Jelliff
T. H. Frison
Chas. H. Behre, Jr.

CONSTITUTION AND BY-LAWS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

CONSTITUTION

Article I. Name

This Society shall be known as The Illinois State Academy of Science.

Article II. Objects

The objects of the Academy shall be the promotion of scientific research, the diffusion of scientific knowledge and scientific spirit, and the unification of the science interests of the State.

Article III. Members

The membership of the Academy shall consist of two classes as follows: *National Members and Local Members.*

National Members shall be those who are members also of the American Association for the Advancement of Science.

Local Members shall be those who are members of the local Academy only. Each member, except life members of the Academy, shall pay an admission fee of one dollar and an annual assessment of one dollar.

Both national members and local members may be either *Life Members, Active Members, or Non-resident Members.*

Life Members shall be national or local members who have paid fees to the Academy to the amount of twenty dollars at one time or complete payments before the annual meeting of 1928. The dues from such a source are to be placed as a permanent fund and only the income is to be used.

Active Members shall be national or local members who reside in the State of Illinois.

Non-resident Members shall be active members or life members who have removed from the State of Illinois. Their duties and privileges shall be the same as active members except that they may not hold office.

Charter Members are those who attended the organization meeting in 1908, signed the constitution, and paid dues for that year.

For election to any class of membership, the candidate's name must be proposed by two members, be approved by a majority of the committee on membership, and be acted upon favorably by a majority vote of the Council.

Article IV. Officers

The officers of the Academy shall consist of a President, a First Vice-President, a Second Vice-President, a Secretary, a Treasurer, a Librarian, and an Editor. These officers, with the exception of the Second Vice-Presi-

dent, the Librarian, and the Editor, shall be chosen by ballot at the annual meeting and shall hold office for one year or until their successors qualify.

The Second Vice-President, who may be a resident of the town in which the next annual meeting is to be held, may be appointed by the Council each year when the next meeting place shall have been decided upon, in order that he may serve as ex-officio chairman of the Committee on Local Arrangements.

The Chief of the State Museum Division of the Department of Registration and Education of the State of Illinois shall be the Librarian of the Academy.

The Editor shall be selected by the Council upon the recommendation of the Committee on Publication.

The above officers shall perform the duties usually pertaining to their respective offices.

It shall be one of the duties of the President to prepare an address which shall be delivered before the Academy at the annual meeting at which his term of office expires.

The Librarian shall have charge of all the books, collections, and material property belonging to the Academy.

The Editor, under the direction of the Committee on Publication, shall have entire charge of the editing and printing of the annual volume of the Transactions and also of such other papers as the Committee on Publication shall deem advisable.

Article V. Council

The Council shall consist of the President, First Vice-President, Second Vice-President, Secretary, Treasurer, Librarian, the retiring president and his immediate predecessor, and the Secretary of the preceding year. To the Council shall be entrusted the management of the affairs of the Academy during the intervals between regular meetings.

At the Annual Meetings the presiding officer of each of the affiliated scientific societies of the State shall meet with the Academy Council for the discussion of policies.

Article VI. Standing Committees

The Standing Committees of the Academy shall be a Committee on Publication, a Committee on Membership, and a Committee on Affiliation and such other committees as the Academy shall from time to time deem desirable.

The Committee on Publication shall consist of the President, the Secretary and a third member chosen annually by the Academy. It shall pass upon the papers published by the Academy, subject to review by the Council.

The committees on Membership and Affiliation shall each consist of five members chosen annually by the Academy.

Article VII. Meetings

The regular meetings of the Academy shall be held at such time and place as the Council may designate. Special meetings may be called by the Council, and shall be called upon written request of twenty members.

Article VIII. Publications

The regular publications of the Academy shall include the Transactions of the Academy and such papers as are deemed suitable by the Committee on Publication.

All paid up members shall receive gratis the current publication of the Academy except in case of emergency.

Article IX. Affiliation

The Academy may enter into such relations of affiliation with other organizations of appropriate character as may be recommended by the Council, and may be ordered by a three-fourths vote of the members present at any regular meeting.

Article X. Amendments

This constitution may be amended by a three-fourths vote of the membership present at an annual meeting, provided that notice of the desired change has been sent by the Secretary to all members at least twenty days before such meeting.

BY-LAWS

I. The following shall be the regular order of business:

1. Call to order.
2. Reports of officers.
3. Reports of standing committees.
4. Election of members.
5. Reports of special committees.
6. Appointment of special committees.
7. Unfinished business.
8. New business.
9. Election of officers.
10. Program.
11. Adjournment.

II. No meeting of the Academy shall be held without thirty days previous notice by the Secretary to all members.

III. Fifteen members shall constitute a quorum of the Academy. A majority of the Council shall constitute a quorum of the Council.

IV. No bill may be incurred against the Academy by officers or committees in excess of five dollars, except as provided for in By-law IX, unless approved by the Council. No bill against the Academy shall be paid without an order signed by the President and the Secretary.

V. Members who shall allow their dues to remain unpaid for three years, having been annually notified of their arrearage by the Treasurer, shall have their names stricken from the roll.

VI. The Librarian shall have charge of the distribution, sale, and exchange of the published Transactions of the Academy, under such restrictions as may be imposed by the Council.

VII. The presiding officer shall at each annual meeting appoint a committee of three who shall examine and report in writing upon the account of the Treasurer.

VIII. No paper shall be entitled to a place on the program unless the manuscript or an abstract of the same shall have been previously delivered to the Secretary. No paper shall be presented at any meeting, by any person

other than the author, except on vote of the members present at such meeting. Manuscript of papers must be handed to the Secretary at the time of the Annual meeting. All papers are limited to twenty pages, additional pages are to be paid for by the author. Except by invitation of the Council, no paper may be accepted for the program unless the author is a member of the Academy or an applicant for membership. No paper shall be accepted for publication which has already been published elsewhere.

IX. The Secretary and the Treasurer shall have their expenses paid from the Treasury of the Academy while attending council meetings and annual meetings. Other members of the Council may have their expenses paid while attending meetings of the Council, other than those in connection with annual meetings.

X. These by-laws may be suspended by a three-fourths vote of the membership present at any regular meeting.

XI. The Treasurer shall maintain a permanent fund for the Academy, only the interest on which may be used. This permanent fund shall consist of (1) life membership dues, (2) donations, and (3) funds as the Council may see fit from time to time to add from accumulations in the treasury.

CONSTITUTION AND BY-LAWS

OF THE

JUNIOR SECTION

ILLINOIS STATE ACADEMY OF SCIENCE

CONSTITUTION

Article I. Name

This organization shall be known as the Junior Section of the Illinois State Academy of Science.

Article II. Objects

The object of this organization shall be to create and foster the best interest of science together with the spirit of American democracy through scientific, moral, and social activities in the various high schools and communities of the state.

Article III. Membership

The membership shall consist of the active members of the various scientific clubs affiliated with the Illinois State Academy of Science, under the rules and regulations prescribed by the latter Society.

Article IV. Delegates

The number of delegates from each club shall be the same regardless of the size of the club.

This number of delegates will be determined annually by the Governing Committee as prescribed in Article VI below.

Only the official delegates of the various clubs shall vote on the matters representing the official business of the organization.

These provisions shall not be construed as barring additional guests from the several clubs as far as accommodations can be provided.

Article V. Officers

The officers of the Junior Section of the Illinois State Academy of Science shall consist of a President, a Vice-President, a Secretary, and a Treasurer.

These officers shall be elected by the delegates from the several clubs represented at the regular annual meetings of the organization.

The above officers shall perform the duties usually pertaining to their respective offices.

Article VI. Governing Committee

The Governing Committee shall consist of the chairman of the Section of the Illinois State Academy of Science designated as "High School Science Clubs," together with such other members as may be elected by the Junior Section.

This committee shall in turn be governed through the Council of the Illinois State Academy of Science, through constitution and by-laws of the latter society in-so-far as they may involve the activities of the Junior Section of the Illinois State Academy of Science.

Article VII. Limitation of Expenses

No bills in excess of $5.00 shall be incurred by the Junior Section without the authorization of the Council of the State Academy.

Article VIII. Bills

No bill against the Junior Section of the Illinois State Academy of Science shall be paid without an order endorsed by the President, Secretary, and Treasurer of the Illinois State Academy of Science and the chairman of the Governing Committee of the Junior Section.

Article IX. Meetings

The regular meeting of the Junior Section of the Illinois State Academy of Science shall be held at such time and at such place as the Council of the Illinois State Academy of Science may designate. Special meetings may be called by the chairman of the Governing Committee, by written notice to the several members of the said committee.

Article X. Affiliation

Affiliation of the various clubs with the Illinois State Academy of Science shall obtain in the manner prescribed by that Society.

Article XI. Dues and Special Assessments

Dues and special assessments in addition to the fees for affiliation above, may be made by the Governing Committee, providing such levies are in keeping with the provisions of Articles VII and VIII above.

Article XII. Amendments

This constitution may be amended by a three-fourths vote of the official delegates present at an annual meeting, and subject to ratification of the Council, provided that notice of the desired change has been sent to the chairman of the Governing Committee and to the Secretaries of the State Academy and the Junior Section of the Illinois State Academy of Science at least twenty days before such meeting.

BY-LAWS

I. The following shall be the regular order of business:

1. Call to order.
2. Reports of officers.
3. Reports of standing committees.
4. Election of members; i. e., recognition of new clubs affiliated with the Academy, etc.
5. Reports of special committees.
6. Appointment of special committees.
7. Unfinished business.
8. New business; roll call of clubs for reports of outstanding activity.
9. Election of officers.
10. Program.
11. Adjournment.

II. The Chairman of the High School Section shall at each annual meeting appoint a committee of three who shall examine and report in writing upon the account of the Treasurer.

III. These by-laws may be suspended by a three-fourths vote of the official delegates present.

AFFILIATED HIGH SCHOOL SCIENCE CLUBS

Arlington Heights, Ill.: Arlington Heights Science Club. (1930.)
Atwood, Ill.: Atwood Phy-Chy Club, High School. (1934.)
Aurora, Ill.: Aurora General Science Club, Junior High School. (1934.)
Bloomington, Ill.: Amateur Burroughs Club. (1931.)
Bloomington Geology Club. (1933.)
Modern Alchemists Club. (1929.)
Charleston, Ill.: Teachers College Science Club. (1934.)

Chicago, Ill.: Botchemzo Club, Parker High School. (1930.)
Bowen Bird Boosters, Bowen High School, 2710 East 89th Street. (1934.)
Crane Tech Zoa-Phyta Club, Crane Tech High School, Oakley and Jackson. (1934.)
Harrison Biology Club, Technical High School. (1930.)
Mendel Science Club, Visitation High School. (1932.)
Morgan Park Science Club, Morgan Park High School, 11043 Hermosa Ave. (1930.)
Senn Science Society, Senn High School. (1934.)
Siena Biology Club, 5600 Washington Blvd.
Siena Chemistry Club, 5600 Washington Blvd. (1931.)
University Science Club, University of Chicago High School. (1934.)
Visitation Chemistry Club, Visitation High School. (1932.)
Volta Science Club, Visitation High School. (1931.)
Waller Science Club, Waller High School. (1934.)
Chicago Heights, Ill.: Bloom Audubon Club. (1932.)
Cicero, Ill.: Morton Biology Club, Morton High School. (1934.)
Morton Chemistry Club, Morton High School. (1934.)
Morton Physics Club, Morton High School. (1933.)
Morton Radio Club, Morton High School. (1934.)
Danville, Ill.: Danville Science Club. (1920.)
DesPlaines, Ill.: Maine Chemistry Club. (1930.)
Dupo, Ill.: Dupo Chemistry Club. (1934.)
Dupo Geology Club. (1933.)
East St. Louis, Ill.: . East St. Louis Junior Scientific Society, High School, (1934.)
Lansdown Science Club, Junior High School. (1934.)
Elgin, Ill.: Senior Science Club, High School. (1934.)
Fairfield, Ill.: Fairfield Science Club. (1932.)
Gillespie, Ill.: Gillespie Science Club. (1931.)
Glen Ellyn, Ill.: Science Club, Glenbard High School. (1930.)
Granite City, Ill.: Vocational Science Club, High School. (1930.)
Grant Park, Ill.: General Science Club, High School. (1934.)
Gurnee, Ill.: Warren Biology Club. (1930.)
Jacksonville, Ill.: Science Club of David Prince Junior High School. (1934.)
Joliet, Ill.: Joliet Biology Club, High School. (1934.)
Joliet Junior Chapter, National Rocks and Minerals Association, High School. (1934.)
Kankakee, Ill.: Edisonian Science Club. (1933.)
McLeansboro, Ill.: McLeansboro Science Club. (1933.)
Milford, Ill.: General Science Club. (1934.)
Mt. Pulaski, Ill.: Mt. Pulaski Science Club. (1930.)
Normal, Ill.: Chem-Mystery Science Club, High School. (1933.)
Paris, Ill.: Illinium Science Club, High School. (1930.)
Pittsfield, Ill.: Pittsfield Chemistry Club. (1933.)
Rockford, Ill.: Rockford Biology Club. (1930.)
Lincoln Chemistry Club, Lincoln Junior High School. (1931.)
Rockton, Ill.: Mote Scientifique, Hononegah Community High School. (1931.)
Timewell, Ill.: Timewell Science Club, High School. (1934.)
Urbana, Ill.: Urbana Science Club, High School. (1934.)
Villa Grove, Ill.: Villa Grove Science Club, High School. (1930.)
West Chicago, Ill.: Edisonian Science Club. (1928.)
Winnetka, Ill.: New Trier Geology Club, New Trier High School. (1931.)
New Trier Ornithology Club, New Trier High School. (1931.)

SCIENTIFIC SOCIETIES AFFILIATED WITH THE ACADEMY

Botany Club of Joliet, care of H. V. Givens, Midland Ave., Joliet, Ill.
Chicago Academy of Science, Lincoln Park, Chicago, Ill. (1925.)
Chicago Nature Study Club, 3842 Byron St., Chicago, Ill., care of Dr. H. S. Pepoon. (1927.)
Illinois Association of Biology Teachers, Mary R. Earnest, Sec'y, Decatur High School, Decatur, Ill. (1928.)
Illinois Association of Chemistry Teachers, H. L. Slichenmeyer, Bloomington High School, Bloomington, Ill. (1928.)
Illinois Nature Study Society of Elgin, Carl F. Gronemann, President, 310 N. Liberty St., Elgin, Ill. (1924.)
Illinois State Library, State House, Springfield, Ill. (1934.)
Knox County Academy of Science, Galesburg, Ill., C. L. Furrow, President. (1923.)
McLean County Academy of Science.
Normal Science Club, Illinois State Normal University, care of Bessie I. Hibarger, Treas., 200 W. Mulberry St., Normal, Ill. (1923.)
Peoria Academy of Science, Arthur L. Epstein, Pres., Peoria High School, Peoria, Ill. (1931.)
Rockford Nature Study Society, care of Miss Frances S. Dobson, 312 N. Avon St., Rockford, Ill. (1923.)
Sigma Xi, University of Chicago Chapter, University of Chicago, Chicago, Ill. (1925.)
Sigma Xi, University of Illinois Chapter, Urbana, Ill. (1925.)
Sigma Zeta Society, care of Prof. R. K. Carleton, Shurtleff College, Alton, Ill. (1929.)
Southern Illinois Science Club, Southern Illinois State Teachers' College, Carbondale, Ill. (1926.)
Theta Chi Delta, Alpha Eta Chapter, Carthage College, Carthage, Ill. (Chemistry.) (1929.)
Theta Chi Delta, Alpha Chapter, Lombard College, Galesburg, Ill. (1934.)
University of Illinois, Branch of the American Chemical Society, Urbana, Ill.

LIBRARIES RECEIVING THE TRANSACTIONS

Academy of Natural Science, Logan Square, Philadelphia, Pa.
Antioch College, Yellow Springs, Ohio.
Armour Institute of Technology, Chicago, Ill.
Augustana College, Rock Island, Ill.
Bradley Polytechnic Institute, Peoria, Ill.
British Museum of Natural History, Cromwell Road, London, England.
Brooklyn Botanic Gardens, Bronx Park, Brooklyn, N. Y.
Butler University, Indianapolis, Ind.
Carnegie Library, Pittsburgh, Pa.
Carnegie Museum, Schenley Park, Pittsburgh, Pa.
Carthage College, Carthage, Ill.
Cleveland Museum of Natural History, 2717 Euclid Avenue, Cleveland, Ohio.
Cleveland Public Library, Cleveland, Ohio.
Colgate University, Hamilton, N. Y.
Colorado Scientific Society, Denver Public Library, Denver, Colo.
Columbia University, New York, N. Y.
Dartmouth College, Hanover, New Hampshire.
Davenport Public Museum, Davenport, Ia.
De Paul University, Chicago, Ill.
Elmhurst College, Elmhurst, Ill.
Enoch Pratt Free Library, Baltimore, Md.
Eureka College, Eureka, Ill.
Geological Survey of Canada, Ottawa, Canada.
Greenville College, Greenville, Ind.
Highland Park Public Library, Highland Park, Ill.
Illinois College, Jacksonville, Ill.
Illinois State Geological Survey, Urbana, Ill.
Illinois State Library, Springfield, Ill. (3 copies.)
Illinois State Natural History Survey, Urbana, Ill.
Illinois Wesleyan University, Bloomington, Ill.
Illinois Womans' College (MacMurray College), Jacksonville, Ill.

Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge, England.
Institute de Biologia Vegetal, Jardin Botanico, Rio de Janeiro, Brazil, South America.
James Millikin University, Decatur, Ill.
Kenyon College, Gambier, Ohio.
Knox College, Galesburg, Ill.
Lake Forest College, Lake Forest, Ill.
Lewis Institute, Chicago, Ill.
Lincoln College, Lincoln, Ill.
Los Angeles Museum, Los Angeles, Calif.
Louisiana State University (Hill Memorial Library), Baton Rouge, La.
Loyola University, Chicago, Ill.
Massachusetts Institute of Technology, Cambridge, Massachusetts.
McKendree College, Lebanon, Ill.
Missouri School of Mines, Rolla, Mo.
Monmouth College, Monmouth, Ill.
Montana State College, Bozeman, Montana.
Mt. Morris College, Mt. Morris, Ill.
Museum of Northern Arizona, Flagstaff, Ariz.
Natural History Museum, San Diego, Calif.
New York State College of Agriculture, Agr. Exp. Sta., Ithaca, N. Y.
North Central College, Naperville, Ill.
Northwestern University, Evanston, Ill.
Ohio State Archeological and Historical Society, Columbus, Ohio.
Ohio State University Library, Columbus, Ohio.
Rockford College, Rockford, Ill.
Rosenwald Museum of Science and Industry, Chicago, Ill.
Scripps College, Claremont, Calif.
Senckenbergische Bibliothek Viktoria-Allee 9, Frankfurt (Main), Germany.
Smithsonian Institution, Washington, D. C.
St. Norbert's College, West De Pere, Wis.
St. Procopius College, Lisle, Ill.
St. Viator College, Bourbonnais, Ill.
Shurtleff College, Alton, Ill.
State Normal University, Normal, Ill.
State Teachers College, Carbondale, Ill.
State Teachers College, Charleston, Ill.
State Teachers College, DeKalb, Ill.
State Teachers College, Macomb, Ill.
Texas Christian University, Fort Worth, Tex.
United States Department of Agriculture, Washington, D. C.
United States Geological Survey, Washington, D. C.
University of Arkansas, Fayetteville, Ark.
University of California, Berkeley, Calif.
University of Chicago, Chicago, Ill.
University of Illinois, Urbana, Ill.
University of Kansas, Lawrence, Kansas.
University of Kentucky, Lexington, Ky.
University of Michigan (General Library), Ann Arbor, Mich.
University of Nebraska, Lincoln, Neb.
University of North Carolina (Department of Geology), Chapel Hill, N. C.
University of Oklahoma, Norman, Okla.
University of Texas, Austin, Tex.
University of West Virginia, Morgantown, W. Va.
Vanderbilt University (Department of Geology), Nashville, Tenn.
Western Reserve University, Cleveland, Ohio.
Weston College, Weston, Mass.
Wheaton College, Wheaton, Ill.
Yale University (Department of Geology), New Haven, Conn.
Yale University (Peabody Museum of Natural History), New Haven, Conn.

NOTICE:—Exchanges from state academies should be addressed to THE LIBRARIAN, STATE MUSEUM, SPRINGFIELD, ILL.

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